

SUPREME COURT STATE OF NEW YORK

COUNTY OF ST. LAWRENCE

INDEX NO. 96061/95

IAS NO. 44-1-95-0516

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REYNOLDS METALS COMPANY,)

Plaintiffs,)

-against-)

AETNA CASUALTY & SURETY)

COMPANY, et al.,)

Defendants.)

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PROTECTED MATERIAL -

REYNOLDS INSURANCE COMPANY LITIGATION

ORIGINAL

Videotaped Deposition of

WILLIAM PAPAGEORGE

Wednesday, July 16, 1997

9:30 A.M.

Reported by:

Tara Schwake, CSR, RPR

1 VIDEOTAPED DEPOSITION of WILLIAM PAPAGEORGE, the
2 witness, taken on behalf of the Defendant Travelers
3 Indemnity Company, on Wednesday, July 16, 1997, at
4 9:30 a.m., at Husch & Eppenberger, 100 North
5 Broadway, Suite 1300, St. Louis, Missouri, 63102,
6 before TARA SCHWAKE, Court Reporter and Notary
7 Public within and for the State of Illinois.

8
9 A P P E A R A N C E S:

10 ANDERSON, KILL & OLICK, P.C.

11 BY: FINLEY T. HARCKHAM, ESQ.

12 1251 Avenue of the Americas

13 New York, New York 10020-1182

14 (212) 278-1543

15 Attorneys for Plaintiff

16
17 WILEY, REIN & FIELDING

18 BY: DALE E. HAUSMAN, ESQ.

19 1776 K Street, N.W.

20 Washington, D.C. 20006

21 (202) 429-7005

22 Attorneys for Defendant

23 The Travelers Indemnity Company

A P P E A R A N C E S (Continued)

MINTZ, LEVIN, COHN, FERRIS, GLOVSKY
AND POPEO, P.C.

BY: NANCY M. REIMER, ESQ.

One Financial Center

Boston, Massachusetts 02111

(617) 542-6000

Attorneys for Defendant

Liberty Mutual Insurance Company

HUSCH & EPPENBERGER

BY: CAROL RUTTER, ESQ.

100 North Broadway, Suite 1300

St. Louis, Missouri 63102

(314) 421-4800

Attorneys for the Witness

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1 WILLIAM PAPAGEORGE,

2 residing at 321 Pebble Valley Drive, St.
3 Louis, Missouri, 63141, having first been
4 duly sworn, was examined and testified as
5 follows:

6 EXAMINATION BY

7 MR. HAUSMAN:

8 Q Could you state your name for the
9 record, please?

10 A William B. Papageorge.

11 Q Current address?

12 A 321 Pebble Valley Drive, St. Louis,
13 Missouri, 63141-8039.

14 Q Okay. Are you currently employed?

15 A Self employed.

16 Q In what capacity?

17 A Technical consultant.

18 Q Again, my name is Dale Hausman, I
19 represent the Travelers Indemnity Company, that's an
20 insurance company, in litigation against Reynolds
21 Metals. Just a few guidelines for this deposition.

22 First of all, because we're making
23 both the paper and oral record, if you could wait
24 for me to finish all of my questions before you
25 answer, I'd appreciate that. That way we're not

1 talking over each other at the same time.

2 A I'll try.

3 Q Okay. And also if you could give
4 audible responses to all the questions, say yes or
5 no rather than a nod or a gesture or something
6 similar.

7 Any questions that you can't
8 understand, that you don't understand or can't hear,
9 please feel free to ask me to rephrase them. We can
10 also have them read back from the, from the record.

11 Also --

12 A You used the word "understanding."
13 Sometimes I have an understanding that may not match
14 your understanding or your intent.

15 Q Right.

16 A So my answer may not quite fit the
17 question.

18 Q Feel free to ask for any
19 clarification, because we do want to make sure that
20 you do understand the question that you're answering
21 so we have a truthful testimony on the record.

22 A Very good.

23 Q And finally, if there are any breaks
24 that you need for any reason, just let me know and
25 I'll be happy to accommodate that. Okay?

1 A Thank you.

2 Q What did you do to prepare for this
3 deposition?

4 A I had discussions with my attorney.

5 Q And that's Ms. Rutter?

6 A Yes.

7 Q Okay. Did you review any documents in
8 preparation for this deposition?

9 A Yes.

10 Q Did you review documents that referred
11 to the Reynolds Metals Company?

12 A Yes.

13 Q All right. When did you meet with
14 your counsel?

15 A Yesterday afternoon.

16 Q Okay. How long was this meeting?

17 A From noon until about 4 or 5 o'clock,
18 as I remember. Most of the afternoon, all of the
19 afternoon, really.

20 Q Okay. Have you spoken with any
21 lawyers representing the Reynolds Metals Company?

22 A No.

23 Q Have you recently spoken with any
24 employees of the Reynolds Metals Company?

25 A I have not.

1 Q Have you given prior deposition
2 testimony before?

3 A Yes.

4 Q Approximately how many occasions?

5 A I have never kept score. It's over a
6 couple dozen times.

7 Q Did that include any insurance
8 coverage litigations, to your knowledge?

9 A Yes.

10 Q And of the dozens or so of depositions
11 that you've given, about how many of those were
12 insurance coverage actions, if you know?

13 A I don't recall the exact number, but
14 it's less than half a dozen.

15 Q And of those less than half a dozen
16 insurance coverage actions in which you've given
17 testimony, did those involve users of Monsanto
18 fluids?

19 A Some of them, yes.

20 Q Do you remember the names of any of
21 those actions?

22 A No, I don't.

23 Q All right. To your recollection, did
24 any of the cases in which you've given testimony,
25 any of the insurance coverage cases involve the use

1 of Monsanto heat transfer fluids?

2 A I don't recall the heat transfer fluid
3 associated with an insurance situation.

4 Q In any of these insurance cases in
5 which you've given testimony, have any of those
6 cases involved hydraulic fluids supplied by
7 Monsanto, to your recollection?

8 A I don't recall.

9 Q Same question for fluids to be used in
10 transformers and capacitors, any recollection of
11 that?

12 A I don't recall anything specific.

13 Q Okay. Have you given trial testimony
14 before?

15 A Yes.

16 Q Okay. And have any of the occasions
17 in which you've given trial testimony been insurance
18 coverage actions?

19 A I don't recall any associated with
20 insurance coverage.

21 Q Okay. On how many occasions have you
22 given trial testimony?

23 A Between, less than half, less than a
24 dozen. Half a dozen to a dozen, somewhere in there.

25 Q Do you recall the nature of the cases

1 in which you've given trial testimony?

2 A I think I can recall some of them.

3 Q Could you tell me that, please?

4 A There was a situation in which the
5 allegation was made that PCBs caused harm to mink in
6 mink ranches up in the northeast.

7 There was a situation in which the
8 dairy farmer claimed that the PCBs affected his
9 cattle herd and the health of his family.

10 There was a case in which the user of
11 a PCB fluid was informed by the regulatory agencies
12 to clean up, and his contention was that Monsanto
13 should participate in the expenses involved.

14 There was another case, let me see.
15 There were three cases that I recall where workers
16 claimed that their health was affected because they
17 were involved with PCB materials. That's all that
18 comes to mind at the moment. I'm sure I missed
19 something there, but --

20 Q That's okay. The case you just
21 described where the user of the PCB fluid was
22 informed by the regulator to clean up, do you know
23 who that user was, do you recall?

24 A Yes.

25 Q What was that company?

1 A Stroh? Gosh, I forgot the official,
2 it's a metal casting process under the name of the
3 Stroh, just like the brewery family up in Milwaukee,
4 Wisconsin.

5 Q Did that case involve heat transfer
6 fluids?

7 A No.

8 Q What type of fluids?

9 A Hydraulic fluids.

10 Q All right. I'd like to sort of get a
11 brief review of your both educational and
12 professional background, so if you could first start
13 by just briefly describing degrees that you received
14 in college or post-graduate?

15 A I received a Bachelor of Science in
16 chemical engineering and the Master of Science in
17 chemical engineering.

18 Q And where were those from?

19 A Washington University in St. Louis.

20 Q Both of them? Both of them?

21 A Yes.

22 Q Okay. And what years did you receive
23 those degrees?

24 A The Bachelor's Degree was awarded in
25 1943; the Master's Degree in 1947.

1 Q Any other formal education beyond
2 that?

3 A Help me with the word "formal." Is
4 this courses for credit towards some degree?

5 Q Yes. Yes.

6 A No.

7 Q Okay. Have you taken courses not
8 designed for a degree, i.e. professional oriented
9 courses?

10 A Yes.

11 Q Okay. Is that something that you've
12 done over the course of your career?

13 A Correct.

14 Q All right. When did you first, when
15 were you first employed by Monsanto?

16 A November of 1951.

17 Q Can you tell me briefly what you did
18 between 1947 when you received your Master's and
19 November of '51 when you started with Monsanto?

20 A 1947?

21 Q '47.

22 A I worked for the Phillips Petroleum
23 Company in Bartlesville, Oklahoma.

24 Q What was the nature of your job there?

25 A For half of that period I worked in

1 the Research Department working with oil wells,
2 drilling fluids and, predominantly in what was
3 called secondary recovery. This is the use of water
4 or air pressure to push the residual oil out of
5 wells that appear to be spent.

6 The latter half of that period I was
7 in their Refinery Design Department doing
8 calculations to help design equipment for refining
9 petroleum.

10 Q Did you have any worker safety
11 responsibilities in that position?

12 A No. Other than the equipment that we
13 eventually end up proposing had to consider the,
14 what I'm going to call the normal safety
15 considerations.

16 Q And in that position did you have any
17 pollution prevention responsibilities?

18 A Well, we practiced the preventions
19 that was common at that point in time. We did not
20 design equipment that would deliberately release
21 materials to the environment.

22 Q So did that work include preventing
23 spills of petroleum products onto the ground or into
24 the water?

25 A The intent was to prevent, yes.

1 Q Okay. In November of 1951 when you
2 began with Monsanto, what was your first position
3 there?

4 A The first position was similar to the
5 one I had just left at Phillips, designing equipment
6 to be used in the manufacture of chemicals, and the
7 initial assignment, of course, just picked up the
8 experience I had in distillation equipment.

9 Q Did that job have a title?

10 A Yes, as I remember, it's Process
11 Engineer, I've forgot if the word "Senior" was
12 attached to that. For sure Process Engineer.

13 Q And where did you do that work? Was
14 that St. Louis?

15 A In St. Louis, yes.

16 Q How long were you a Process Engineer?

17 A Oh, about three years.

18 Q As a Process Engineer did you design
19 equipment for the manufacture of heat transfer
20 medium fluids?

21 A No.

22 Q How about hydraulic fluids?

23 A No.

24 Q How about transformer or capacitor
25 fluids?

1 A No.

2 Q Did you design any equipment at that
3 time for the manufacture of any fluids that
4 contained PCBs?

5 A No.

6 Q What were the nature of the chemicals
7 for which you designed machinery at that time?

8 A It was phthalic anhydride,
9 p-h-t-h-a-l-i-c a-n-h-y-d-r-i-d-e, which is a
10 material that is further processed to make what is
11 known as a family of plasticizers. These are
12 materials that are added to plastics to make them
13 pliable, flexible instead of brittle.

14 Q So is it correct that you were a
15 Process Engineer until 1954?

16 A Roughly so, yes, sir.

17 Q What did you do then?

18 A I was assigned to work in an
19 operation, a department as we call them at the
20 plant, which made these plasticizers I just referred
21 to, under the guidance of a Senior Supervisor. It
22 was a sort of a training, learning exposure.

23 Q And what was the nature of the
24 activities that you were trained in at that point?

25 A Well, it was the supervising of the

1 foremen who in turn supervised the workers, making
2 sure that the scheduled production was being met,
3 that the quality of the material met the
4 specifications, that all the necessary coaching and
5 training of the workers took place, safety meetings
6 and the like.

7 Q And your role was what, your role was
8 the training function, overseeing the training
9 function?

10 A That's just part of it.

11 Q Okay. And how long did you do that?

12 A About a year.

13 Q Okay. What did you do after that?

14 A I was given my own producing unit
15 instead of being a trainee.

16 Q And that was for plasticizers still?

17 A No, this was a, a production unit that
18 made chemicals that are eventually used in, as
19 rubber additives, or in the manufacture of rubber
20 additives.

21 Q Did any of those chemicals contain
22 PCBs?

23 A No.

24 Q And your role was oversight of that
25 unit?

1 A Yeah, I'll use the word, I was boss of
2 the unit.

3 Q Where was that, is that still in St.
4 Louis?

5 A The same plant, still in St. Louis.

6 Q Okay. How long did you do that?

7 A Couple years, as best I recall.

8 Q Do you know where that takes us? Does
9 that get us up to 1960?

10 A I think we're about '57 or
11 thereabouts.

12 Q Okay. And what did you do then?

13 A I was transferred then to the plant's,
14 excuse me, Maintenance Department, Engineering and
15 Maintenance Department as a Maintenance Supervisor.

16 Q And that's still in St. Louis,
17 correct?

18 A Yes, same plant.

19 Q How long did you do that?

20 A Couple years.

21 Q Did that plant at that time, from 1957
22 for the next couple years, did that plant make any
23 PCB containing fluids?

24 A Yes. The plant blended ingredients
25 that resulted in the PCB containing material.

1 Q When you say "that resulted in PCB
2 containing material," what types of materials would
3 that be?

4 A Primarily the hydraulic fluid
5 products.

6 Q As a Maintenance Supervisor, did you
7 have responsibility for preventing releases of these
8 hydraulic fluids onto the ground or into the
9 waterways?

10 A No.

11 Q Was there somebody at that time that
12 had that responsibility?

13 A Oh, yes. Many people did.

14 Q Okay. Was there a, a department or a
15 title of a person who had that type of
16 responsibility to prevent these releases?

17 A Not at that time.

18 Q When you say "many people," who do you
19 refer to?

20 A Every person at the plant who had some
21 supervisory responsibilities, from the Chief
22 Operator to the Foreman to the Assistant Supervisor
23 to the Supervisor, the Superintendent, all the way
24 to the Plant Manager where the buck stops has that
25 as part of their responsibility, and the theme at

1 the time was respect all materials you handle. All
2 of them. Because even the water can be scalding
3 hot.

4 Q At the time, in the late '50s, was
5 there a general awareness in Monsanto that releasing
6 hydraulic fluids into waterways or onto the soil
7 could result in damage to the water or soil?

8 MR. HARCKHAM: Objection, lack of
9 foundation.

10 Q (By Mr. Hausman) Can you answer that?

11 A Well, the thought wasn't limited just
12 to hydraulic fluids. Any material that was handled
13 in the plant should not get into the waterways.

14 Q All right.

15 A That was the objective.

16 Q Is this objective something that you
17 were told in your role?

18 A Well, yes. It was like breathing.

19 Q All right.

20 A It was, it was part of the discussion,
21 part of the orientation, part of the safety
22 meetings, it was covered all over and over again.

23 Q Okay. Is it fair to say that that
24 objective of not releasing any of these materials
25 onto the ground or waterways was known by all

1 employees throughout the plant?

2 MR. HARCKHAM: Objection, lack of
3 foundation.

4 A I cannot speak for all employees,
5 because some of them were in clerical positions and
6 not near chemicals, so those employees that were
7 involved with these materials were certainly
8 coached, tutored, trained, constantly reminded.

9 Q (By Mr. Hausman) All right. And as
10 far as worker safety issues, were there precautions,
11 we're talking in the late 1950s, for being exposed
12 to hydraulic fluids?

13 A Nothing other than the usual
14 precautions of don't get it on your skin, wash your
15 hands at the first chance you get. Don't breathe
16 fumes, if they're bad, don't go into the area; if
17 you have to, use a respirator. If your shoes are
18 soaked in the material, get a new pair of shoes.
19 Don't keep wearing them. That type of message was
20 always preached, if you will.

21 Q And those were common procedures at
22 the time?

23 A For almost all the companies.

24 Q In your role as Maintenance
25 Supervisor, did you have any responsibilities for

1 providing information to customers?

2 A No.

3 Q All right. Was there somebody in the
4 plant at the time who had that responsibility?

5 A In the plant there were people who, on
6 occasion, would be asked by the marketing
7 representatives to participate in discussions with
8 customers. This was looked upon as a resource to
9 the, to the Monsanto representative out in the
10 marketing field, that if a question came up that he
11 didn't feel he knew enough about to respond
12 properly, he could call some individuals at the
13 plant and get the assistance.

14 Q All right. Again, if you know the
15 answer to this, do you know whether, again, the time
16 period of 1957, late '50s, Monsanto issued any
17 warnings for the dangers or hazards of any of its
18 substances to its customers?

19 A Certainly, where it was appropriate,
20 yes.

21 Q Do you know when a, specific warnings
22 of hazards were issued with regard to hydraulic
23 fluids at that time?

24 A I recall some paragraphs in the
25 brochures that were available that would describe

1 the product and its uses, and am also aware that the
2 product label had a message regarding exposure to
3 the material.

4 Q Were these brochures and labels
5 something you saw at the time that you were in this
6 position as Maintenance Supervisor?

7 A I'm sorry?

8 Q Let me repeat that. Were these
9 brochures and labels something that you saw in your
10 position as Maintenance Supervisor?

11 A Yes. Oh, in fact I consulted them
12 from my own work force, if they run across this
13 material, they had to know this.

14 Q Do you have any awareness in this
15 period of the late '50s of whether Monsanto sold any
16 of these hydraulic fluids that were made at the
17 plant to the Reynolds Metals Company?

18 A I just don't recall the dates. Late
19 '50s, I don't remember that.

20 Q Okay. After you were the Maintenance
21 Supervisor, what was your next position?

22 A I was made the Superintendent of the
23 Maintenance Department.

24 Q And how long did you do that?

25 A About, until about 1960? Two or three

1 years.

2 Q And did you have any responsibilities
3 for customer relations in that job?

4 A No.

5 Q Did you have any responsibility for
6 the formulation of worker safety precautions and the
7 handling of various materials?

8 A I was a participant whenever a program
9 would be developed or when an existing program would
10 be reviewed and revised if necessary. Yes, I would
11 participate.

12 Q What would be the nature of your
13 participation?

14 A Well, it was sort of offering my
15 personal impressions regarding the proposed approach
16 to teaching the work force on how to control leakage
17 and how to control exposure, and I would, being a
18 member of the Maintenance Department, would take the
19 position of the mechanic who breaks into a pipeline
20 and that this material spills out all over his
21 coveralls, that kind of, so I kind of try to fulfill
22 that role, when the program would be developed under
23 what do you do under these conditions.

24 Q All right. Did the plant itself use
25 Monsanto's own hydraulic fluids in its machinery?

1 A Oh, yes.

2 Q And were there procedures to prevent
3 the leakage of this machinery?

4 A Oh, yes.

5 Q Were there written procedures?

6 A I'm sorry?

7 Q Were there written procedures?

8 A Some of the equipment had written
9 procedures, but most of the principles of
10 controlling leakage and loss were common to most
11 liquid handling systems under pressure, under heat,
12 and there are some practices that evolved through
13 time on how to drain a system before you disconnect
14 and what to do with the drained material, and it
15 depends on whether you can reuse it or it must be
16 discarded, how to clean up a spill on a concrete
17 floor, that type of subject would be --

18 Q Were there specific procedures on how
19 to dispose of hydraulic fluids?

20 A Were there?

21 Q Yes.

22 A When you say "specific," are you
23 referring specific to the fluid or specific
24 procedure on where to go in the plant?

25 Q Fair enough, the latter, but let me

1 refine that question. Were there any prohibitions
2 at the time for, against disposing of hydraulic
3 fluid into waterways?

4 A Oh, yes. Yes.

5 Q And that was prohibited, let's be
6 clear?

7 MR. HARCKHAM: Just for clarification,
8 what time period are you asking him about?

9 MR. HAUSMAN: When Mr. Papageorge was
10 supervisor of the Maintenance Department, I think it
11 was still in the late 1950s.

12 A 59, up to 1960 or so, yes.

13 Q (By Mr. Hausman) And what were the
14 reasons for that prohibition?

15 MR. HARCKHAM: Objection, lack of
16 foundation.

17 Q (By Mr. Hausman) If you know.

18 A The plant is located in metropolitan
19 St. Louis area. Its waste waters enter the
20 metropolitan sewage treatment system. Introducing
21 many chemicals into that waste could upset the
22 treatment plant, which uses bacteria to decompose
23 the waste. So one of the reasons for it being a,
24 I'm going to call it a no-no, is you didn't want to
25 upset the treatment plant of the, this area.

1 Q Okay.

2 A And then there's the desire not to,
3 not to put large amounts of chemicals into the
4 sewer. Now, the occasional drip that is hosed down
5 and gets into that water, that's extremely hard to
6 control. It's like the oil spot on your garage
7 floor. But even then we would discourage, where
8 possible, this hosing until at least an attempt was
9 made to pick up the fluid that could be picked up,
10 either with rags or sawdust, some means, that you
11 take that solid material and you take it to a proper
12 landfill for disposal.

13 Q When you say "proper landfill," what
14 do you mean?

15 MS. RUTTER: Objection, lack of
16 foundation.

17 Q (By Mr. Hausman) Again, if you know.

18 A Well, the intent, and you got to keep
19 in mind that it's an evolving kind of situation. At
20 that time, the landfill that was selected would be
21 one that was not near any waterway, there was no
22 evidence that there was underground water that's
23 moving through, picking up contaminants and taking
24 them where they would be undesirable.

25 Q As the Maintenance Superintendent, did

1 you have responsibilities for the disposal of
2 fluids?

3 A No.

4 Q Was that somebody in your department
5 or a different department?

6 A Different department.

7 Q What was that department?

8 A What was that department?

9 Q Yeah.

10 A There was a function in the plant
11 which was a sort of a group to assist the
12 Manufacturing Departments with the movement of
13 material, whether it be the raw material going to
14 their operation or the finished product leaving the
15 operation, getting rid of its trash, supplying it
16 with steam and water and electricity, sort of
17 assisting the Operating Department. That is the
18 department that arranged for the trash and waste
19 chemical pickup services.

20 Q Okay. Now, let me ask you this. We
21 spoke earlier of brochures that went to customers
22 and warning labels. In the time period around 1960,
23 as a general practice, would the brochures for
24 products that Monsanto sold include information on
25 proper disposal methods for those fluids?

1 MR. HARCKHAM: Objection, lack of
2 foundation.

3 MS. RUTTER: I join.

4 A At that time?

5 Q (By Mr. Hausman) Yes.

6 A I don't recall any example of a
7 proposed disposal method other than for some
8 chemicals there were words to the effect, "Be
9 careful," but they didn't ever reach the point, "You
10 got to take it to ABC Landfill" or anything like
11 that.

12 Q Okay. All right. After you were
13 Superintendent of the Maintenance Department, what
14 did you do?

15 A I was then made a Technical Services
16 Superintendent, which was really the, the group that
17 I had originally served in as a Process Engineer, I
18 was now supervising engineers and technicians who
19 were assigned technical problems to solve, and help
20 the manufacturing people wherever the manufacturing
21 people would perceive a problem of any kind.

22 Q Okay. This was at the St. Louis plant
23 still?

24 A Still, yes.

25 Q Okay. And what were the years that

1 you were in that position?

2 A I think that lasted a couple three
3 years, '62 or '63? My memory's not real sharp on
4 these dates, so it's --

5 Q I understand.

6 A That's decades ago.

7 Q I understand. In that position did
8 you have any customer services responsibilities?

9 A Not as a responsibility, per se, but
10 as a, an assist to a fellow Monsanto salesman, yeah,
11 I would participate.

12 Q What type of assistance in general
13 would you provide to a salesman?

14 A Oh, I can't think of a specific at the
15 moment, but it would fall under the engineering
16 assignment that I had where someone may say, "I'm
17 proposing to put in, say, a pump. What kind of pump
18 do you folks use?" And, well, we'd share that
19 information with them and then we'd tell them, "For
20 us, this works. It may not work for you." Then
21 we'd, we'd participate in that kind of thing.

22 Q All right. Do you recall providing
23 any assistance to customers through the salesperson
24 on construction of heat transfer machinery?

25 A I don't recall any.

1 Q Do you recall providing any assistance
2 to customers through the salespeople on recommending
3 pumps for hydraulic systems?

4 A My recollection is not that good. I
5 can't remember.

6 Q Okay. What did you do after you were
7 Technical Services Superintendent?

8 A I was then assigned as a General
9 Superintendent of this department I described
10 earlier that assisted the production people with
11 delivery of materials, the utilities, trash hauling.

12 Q And what were the years that you did
13 that?

14 A '62 and 3, somewhere in there.

15 Q Until when?

16 A I'm sorry?

17 Q Until when?

18 A 1962 and 1963 period.

19 Q So you did that for a short amount of
20 time?

21 A Couple of years, yes.

22 Q Did you have any increased
23 responsibility from the Technical Services
24 Superintendent for Customer Services?

25 A Well, since I was involved with the

1 shipping function, on occasion, and this didn't
2 happen often, I would get involved with delivery of
3 the product to the customer in the right container
4 or the right vehicle or on time, I would get
5 involved with that kind of thing, but I had a, a
6 good staff to handle the majority of those cases. I
7 would only get involved in their absence or if there
8 was some problem that they couldn't handle.

9 Q Okay. Did you have any involvement in
10 communicating any potential hazards to the customer?

11 A No.

12 Q Okay. After that position as General
13 Superintendent, what did you do?

14 A I was made a General Superintendent of
15 Manufacturing at the Monsanto Plant located in,
16 across the river from St. Louis.

17 Q Is that the Sauget Plant?

18 A The Sauget Plant.

19 Q Okay. And did you have any customer
20 services responsibilities in that position?

21 A Again, on occasion, I would be
22 involved with a, a dialogue with a customer and its
23 representatives regarding one of the products that
24 my particular group was manufacturing.

25 Q Would that dialogue include advice on

1 any potential hazards of the product?

2 A I don't remember specific, but that's
3 a very appropriate subject, yes.

4 Q And what were the nature of the, what
5 was the nature of the products that your group was
6 manufacturing?

7 A There were several, I can't propose to
8 say I remember all of them, but I do remember we
9 made, in our group we made phenol, something known
10 as carbolic acid, we made a sodium phenate, which is
11 the salt of that carbolic acid --

12 Q Well, let me ask you this. Were any
13 of those products PCB containing fluids?

14 A No.

15 Q Okay. How long were you in that
16 position?

17 A Until 1965.

18 Q And what did you do after that?

19 A I was assigned to the Plant Manager
20 in, at the plant in, Monsanto's plant in Anniston,
21 Alabama.

22 Q And did that plant manufacture any PCB
23 containing fluids?

24 A Yes.

25 Q Okay. What fluids did they

1 manufacture?

2 A There was a series of PCB mixtures
3 that we at Monsanto referred to as Aroclors,
4 A-r-o-c-l-o-r, followed by a four digit number to
5 designate the type of mixture in that particular
6 batch of material that was made.

7 Q Were those, did, let me start over.
8 Did those mixtures include heat
9 transfer medium fluids?

10 A Some of the Aroclor mixtures were
11 marketed under the heat transfer brand.

12 Q And in your role as Plant Manager, did
13 you have any responsibility for overseeing any
14 research into potential hazards of these Aroclors?

15 A Research into it?

16 Q Yes.

17 A No.

18 Q Was there such a function at that
19 plant?

20 A Not at the plant.

21 Q Was there a function in the Monsanto
22 corporate umbrella?

23 A Yes.

24 Q And where did that take place?

25 A That was Monsanto's Central Medical

1 Department, located in St. Louis.

2 Q Did that Central Medical Department,
3 to your knowledge, create reports on hazards of
4 Aroclors?

5 A Yes.

6 Q And as a Plant Manager in Anniston,
7 did you have occasion to see such reports?

8 A Oh, yes.

9 Q Did you receive those as a matter of
10 course?

11 A Yes.

12 Q And as the Plant Manager at Anniston,
13 did you have, again, customer services
14 responsibilities?

15 A On occasion.

16 Q What was the nature of your
17 responsibilities there?

18 A It would be varied. As I indicated
19 earlier, sometimes it had to do with the shipment of
20 the finished product. There were times when a
21 customer would want to visit our plant and see how
22 we handled things and what kinds of equipment we
23 used and, in terms of the routine as well as the
24 safety equipment. So we would be more than happy to
25 share what we had with them, and that happened

1 fairly frequently.

2 Q Mm-hmm. Did anybody at the Anniston
3 Plant provide advice on types of machinery that
4 customers could use for the Aroclors?

5 MS. RUTTER: Objection, overbroad,
6 lack of foundation.

7 MR. HARCKHAM: Same objection.

8 Q (By Mr. Hausman) Do you understand
9 the question or do you need me to rephrase that?

10 A When you say "types of machinery," I'm
11 thinking of pumps and instruments, you mean, to
12 control and all of that?

13 Q Sure.

14 A Well, the plant was not in a position
15 to give good advice regarding that because they
16 didn't know enough about the customer's operation to
17 do that. We, at best we could just say, "Here's
18 what we use under these conditions."

19 Q All right. Did the plant in Anniston
20 provide any advice on ways to operate a heat
21 transfer medium system that used Aroclors?

22 A We would tell them how, how our heat
23 transfer system worked, we'd even point it to them,
24 but that didn't mean his system was anything like
25 ours, what was expected of it and so on.

1 Q So beyond showing what Anniston had,
2 there wasn't a consulting role on heat transfer
3 medium machinery?

4 A No, we didn't feel we were qualified
5 to do that.

6 Q Now, as a general practice at
7 Anniston, would somebody at the plant advise
8 customers of hazards of Aroclors?

9 MR. HARCKHAM: Are you talking about
10 when he was Plant Manager?

11 Q (By Mr. Hausman) That's right.

12 A I hesitate because I don't know all of
13 the conversations my staff had with customers.

14 Q Okay.

15 A It wouldn't surprise me if somebody
16 did come up, they would share with the customer what
17 they knew and what they did.

18 Q Well, on the occasions where you spoke
19 with customers -- let me, let me ask the question
20 first. Were there occasions when you spoke with
21 customers, first of all?

22 A Yes, there were.

23 Q Okay. And on those occasions were
24 there times when you would communicate hazards,
25 potential hazards of Aroclors?

1 A Yes.

2 Q And would that be similar to the
3 information that you, that you would learn in the
4 reports that were prepared by the Central Medical
5 Department?

6 MR. HARCKHAM: Objection, vague and
7 ambiguous.

8 MS. RUTTER: I join.

9 A My comments were based on my personal
10 observations, experience at the plant, as well as
11 the reports that Central Medical Department would
12 submit.

13 Q (By Mr. Hausman) Okay. Fair enough.
14 Okay. How long were you the Plant Manager at
15 Anniston?

16 A Until the end of 1969.

17 Q Okay. What did you do after that?

18 A I was appointed as Manager,
19 Environmental Control reporting to the unit in St.
20 Louis that was responsible for the marketing of
21 PCBs.

22 MR. HARCKHAM: Just, off the record
23 for a second, if we're getting to a new subject, if
24 we could just take a minute break or two?

25 MR. HAUSMAN: Okay. Let's go off the

1 record.

2 (A brief recess was held at this
3 time.)

4 Q (By Mr. Hausman) Okay, Mr.
5 Papageorge, when you were the Manager of
6 Environmental Control, where did you work out of?

7 A Out of St. Louis.

8 Q So you came back to St. Louis around
9 that time?

10 A Yes, I did.

11 Q Was that at a plant or at a corporate
12 location?

13 A It was at the corporate headquarters
14 of Monsanto.

15 Q Was the Manager of Environmental
16 Control a newly formed position?

17 A Yes.

18 Q Were you the first person to hold that
19 position?

20 A Yes.

21 Q Were you ever told why that position
22 was created?

23 A Yes.

24 Q And what were you told?

25 A There was an issue related to PCBs and

1 their presence in the environment in surprising
2 samples. Unexpected presence. The issue was being
3 addressed by university laboratories, government
4 agencies, some industries, and it became a situation
5 where so much was going on so quickly that the,
6 Monsanto decided they better have somebody to serve
7 as a focal point, if you will, to try to keep up
8 with what was going on not only within Monsanto, but
9 with its customers, with the representatives of the
10 governmental entities, with other producers of PCBs.

11 So my role was to try to keep up to
12 date with all new developments and share that
13 information with anybody what could use it, could
14 contribute. So I saw myself as really someone who
15 left, who tried to have the left hand know what the
16 right was doing, if you will.

17 Q In your role, did you specifically --
18 let me start that over.

19 In your role did you have direct
20 interactions with customers?

21 A Yes.

22 Q Did you meet with customers?

23 A Yes.

24 Q All right. Did you have occasion to
25 make visits to customers' facilities?

1 A On occasion, yes.

2 Q How often would you do that?

3 A I find it hard to describe the
4 frequency. I recall my first summer on the
5 assignment, I made a concerted tour of the big users
6 of PCBs, which were primarily the electrical
7 equipment manufacturers, and the rest of the time it
8 was really on an invited as need basis, when I would
9 be invited to attend and participate in discussions
10 and plant tours and the like.

11 Q Okay. Was Reynolds Metals Company one
12 of the big users?

13 A They were a, I have a hard time
14 comparing, they were not as big, say, as General
15 Electric, but they were, a respectable amount of
16 material went to their operations.

17 Q Let me ask you this. Were they
18 included on the group of companies that you toured
19 initially?

20 A I, no.

21 Q They were not. Did you personally
22 ever travel to Massena, New York, to visit the
23 Reynolds Metals facility there?

24 A No.

25 Q At some point did Reyn -- let me start

1 again.

2 At some point did Monsanto make a
3 decision to discontinue the sale of PCB fluids?

4 A Yes.

5 Q Okay. Did you have a role in that
6 decision making?

7 A Yes.

8 Q What was the nature of your role?
9 Were you the one who made the decision, or did you
10 make a recommendation?

11 A I made a recommendation to a Vice
12 President of the company.

13 Q Did you have any reporting role to a
14 Vice President?

15 A Not direct.

16 Q Who did you report to, if anybody?

17 A At this point in time that we're
18 talking about?

19 Q Yes. Yes.

20 A At this point in time I reported to
21 the director of the business group that marketed
22 fluids for use in industry, whether they be in
23 electrical equipment or heating equipment or
24 hydraulic systems.

25 Q And did you have a staff as, when you

1 were the Manager of Environmental Control?

2 A No.

3 Q So you worked by yourself?

4 A Yes.

5 Q Did you coordinate in that position
6 with any sales departments or sales personnel?

7 A Oh, yes.

8 Q Outside of sales was there a customer
9 services function in Monsanto?

10 A At Monsanto we had a group we referred
11 to as Customer Services, they were the people that
12 handled the details of the orders, the invoicing,
13 keeping score on when deliveries should be made and
14 how much and where to and who to send the bills to,
15 they got involved with these kinds of things.

16 Q Was sales a part of the Customer
17 Services function?

18 A No. They, the Customer Services
19 supported the sales.

20 Q And in your role as Manager of
21 Environmental Control, did you also work with the
22 Customer Services Department?

23 A Oh, yeah, occasionally, yes.

24 Q Okay. How long were you the Manager
25 of Environmental Control?

1 A I hesitate because my job didn't
2 change, but my title changed.

3 Q Okay. When did your title change?

4 A It was decided, I've got to smile as I
5 think back, that we really couldn't control the
6 environment but we could protect it, so my title was
7 changed to Manager, Environmental Protection, and
8 this happened about 1972, '71, '72?

9 Q Did your responsibilities change at
10 all?

11 A Not at that time.

12 Q Was there a time later when your
13 responsibilities as Manager, Environmental
14 Protection changed?

15 A There was a, in 1973, as best I
16 recall, Monsanto, through its subgroup called the
17 Monsanto Industrial Chemicals Company, appointed
18 individuals with a title of Managers of Product
19 Acceptability. So in '73 I was given that title. I
20 retained my responsibilities relating to PCBs and I
21 was assigned additional products.

22 Q And those were non-PCB products?

23 A Correct.

24 Q All right. And as you were assigned
25 these additional products, were, were you assigned

1 an environmental protection function with regard to
2 those products?

3 A That was one of the considerations.

4 Q Okay. What other considerations?

5 A Well, it had to do with the quality of
6 the material, the packaging, the proper labeling,
7 the proper shipping, the brochures that were issued,
8 the understanding of the field salesmen of this new
9 environmental world that was evolving around them.
10 So that the expression "Product Acceptability"
11 covered all of those and had to be acceptable not
12 only to the customer, but to society, to the
13 government, to Monsanto. Did it meet all of these
14 evolving new considerations.

15 Q Okay. When you retained this
16 additional responsibility as Manager of Product
17 Acceptability, did the products in that category
18 include products that were used to replace the PCB
19 containing fluids that were previously used?

20 A Yes.

21 Q Okay. Then how long were you the
22 Manager of Environmental Protection?

23 A From, Environmental Protection?

24 MR. HARCKHAM: Excuse me, I just don't
25 understand your question. Are you talking about the

1 1970 job or the '73 job?

2 Q (By Mr. Hausman) Yeah, let me step
3 back. Did you become in '73 the Manager of Product
4 Acceptability? Let me start over.

5 In 1973 when you assumed this duty as
6 Manager of Product Acceptability, did you retain
7 also your duties as Manager of Environmental
8 Protection?

9 A Yeah. The activities associated with
10 the Environmental Protection assignment as it
11 relates to PCBs were transferred under the Product
12 Acceptability title --

13 Q Okay.

14 A -- and spread out over all products,
15 not just PCBs.

16 Q Okay. I understand. So in 1973 your
17 title became Manager of Product Acceptability?

18 A Correct.

19 Q That was your sole title?

20 A I'm sorry?

21 Q That was your sole title, correct?

22 A Yes.

23 Q Okay. How long did you do that?

24 A I believe it was 1976.

25 Q Okay. What did you do then?

1 A There was a Monsanto reorganization,
2 and the unit I was assigned to was the Monsanto
3 Intermediate Chemicals Company, and I was given the
4 assignment of Director of Environmental Operations
5 for that unit in Monsanto.

6 Q And what were intermediate chemicals?

7 A These are materials that are used by
8 our customers or within Monsanto to further process
9 to make a product that has a, either an obvious end
10 use or can be blended with other materials to make a
11 product that can be used in commerce that is
12 acceptable to somebody. So it's an intermediate
13 step in the evolution of a group of chemicals.

14 Q At the point in time when you became
15 the Director of Environmental Operations for the
16 Intermediate Chemical Company --

17 A At that point, is --

18 Q At that point in time, did any
19 Monsanto company make PCB containing fluids?

20 A Oh, yes.

21 Q Did the Intermediate Chemical Company
22 make those fluids?

23 A No. That was over their -- oh, the
24 Intermediate Chemicals?

25 Q Yes.

1 A No. That was over in the Industrial
2 Chemicals Group.

3 Q And you had no responsibilities for
4 the Industrial Chemicals at that time?

5 A At that time I entered, in the first
6 six months or so of that assignment, I was still
7 involved with PCBs, but in, let me think a bit. I'm
8 confusing the dates in my mind. Let me back off.

9 In February of 1976, I transferred my
10 PCB responsibilities to another person in Monsanto.

11 Q Who was that?

12 A J.C. Weber. I'm pretty sure it was
13 February, '76.

14 Q Is that with one B or two Bs?

15 A One B. So when I was appointed the
16 Director, Environmental Operations later that year,
17 I did not have the PCB responsibilities any longer.

18 Q Okay. That's really what I was
19 driving at. After February, 1976, did you have any
20 responsibilities at Monsanto for PCB fluids in any
21 sense?

22 A Yes, I did. I still had some
23 responsibilities.

24 Q Okay. What responsibilities did you
25 retain?

1 A I'm, of course, being Director,
2 Environmental Operations for this group, the plants
3 assigned to that group had to handle PCBs the way
4 we'd been telling everybody. So I wasn't completely
5 divorced from PCBs.

6 Q Okay. What were, what was the nature
7 of your responsibility with regard to PCBs when you
8 became the Director of Environmental Operations for
9 the Intermediate Chemical Company?

10 A In 1976, it was my responsibility to
11 see that all of the suggestions and regulations and
12 anything that related not only to PCBs but all
13 chemicals were being followed at the plants assigned
14 to this subgroup within Monsanto.

15 Q Okay.

16 A This had to do with more attention to
17 maintenance, incineration of PCBs in liquids, the
18 proper disposal of the solid wastes, the changeout
19 of fluids in the equipment where an alternate
20 material was available. You see, by 1976, a good
21 bit of that was in place. It was a way of
22 operating, become fairly routine.

23 Q Okay. Do you know whether after
24 February, 1976, when you came into this role,
25 whether Reynolds Metals Company was one of the

1 customers that you had continued involvement with
2 regard to PCBs over?

3 A In '76?

4 Q Yeah.

5 A I was not personally involved with
6 Reynolds at that point in time.

7 Q Do you know whether they fell into the
8 jurisdiction, as it were, of the Intermediate
9 Chemical Company, or do you know if that was with
10 the Industrial Chemicals Group?

11 MR. HARCKHAM: Objection, vague,
12 ambiguous.

13 A It would have to be Industrial
14 Chemicals.

15 Q (By Mr. Hausman) So just to close
16 out, do you recall having any involvement after
17 February, 1976, with Reynolds Metals Company in any
18 way?

19 A That is true. I don't remember any.

20 Q You don't remember any, okay. Okay,
21 and how long were you in this position of Director
22 of Environmental Operations for the Intermediate
23 Chemical Company?

24 A 1983, '82? I retained the title of
25 Director, Environmental Operations, but then was

1 assigned to the Industrial Chemicals Company. There
2 was another reorganization where the Intermediate
3 Chemicals unit was dissolved.

4 Q Okay. And how long did you do this?

5 A Until 1985.

6 Q And at that period from '82 or '83 to
7 '85, do you have any recollection of being involved
8 in any way with the Reynolds Metals Company?

9 A No.

10 Q What did you do in 1985?

11 A Another reorganization took place and
12 I was made, I think the title was Manager of
13 Occupational Health for the Monsanto Company, which
14 was the new designation of a combination of all
15 these other subgroups that we talked about earlier.

16 Q Okay. Did this deal with occupational
17 health for Monsanto employees or for customers?

18 A Monsanto employees.

19 Q And how long did you do that?

20 A Until I retired at the end of 1986.

21 Q And you have been a consultant since
22 then?

23 A Yes.

24 Q Over the course of your employment
25 with Monsanto, were you a member of any trade

1 associations?

2 A Can you help me with your expression
3 "trade association"?

4 Q Sure. Why don't I give you
5 categories. Were you a member of any organizations
6 that dealt with worker safety?

7 A No.

8 Q Were you a member of any organizations
9 that dealt with environmental matters?

10 A The reason I'm hesitating, I played
11 some role in these kinds of matters, but I didn't
12 picture myself as being a member. I was
13 representing Monsanto, which was the member.

14 Q Did you participate in any seminars of
15 any groups that dealt with environmental matters?

16 A Oh, yes. I wish I could remember them
17 all, but there were --

18 Q It's a large number?

19 A Yes. Yes.

20 Q Okay. Were you a member of any
21 chemical or chemical engineering societies?

22 A Yes.

23 Q Do you remember the names of those?

24 A I'm a member of the American Chemical
25 Society and the American Institute of Chemical

1 Engineers.

2 Q Okay. Have you ever been a member of
3 I think the American Industrial Hygiene Association?

4 A No.

5 Q Okay. When you were Manager of
6 Environmental Control and later Manager of
7 Environmental Protection and Manager of Product
8 Acceptability, those three positions, did you
9 receive trade publications on environmental issues?

10 MS. RUTTER: Objection to the
11 overbroad and vague form of the question.

12 A Yes, I did. I don't remember all
13 their titles now.

14 Q (By Mr. Hausman) Did you receive a
15 broad range of such publications?

16 A I have no way to measure the range.

17 MR. HARCKHAM: I'm just going to say,
18 I don't understand whether you're asking him whether
19 he received things throughout that period or at any
20 time during that period.

21 Q (By Mr. Hausman) My question was
22 broad enough to include both, I think.

23 A I would receive periodicals, some of
24 which I personally subscribed and some that were,
25 may have just arrived in the mail to me. I just

1 don't remember them all.

2 Q Did you receive similar periodicals
3 when you were the Plant Manager at Anniston,
4 Alabama?

5 MR. HARCKHAM: Objection, vague and
6 ambiguous.

7 MS. RUTTER: I join.

8 A Any environmental periodicals when I
9 was Plant Manager?

10 Q (By Mr. Hausman) Yes.

11 A I don't remember any such thing
12 existing. I never saw anything then.

13 Q Okay. When you became the Manager,
14 Environmental Control, did you take it upon yourself
15 to read the literature that dealt with health and
16 safety and PCBs?

17 A That was a very important part of my
18 assignment, yes.

19 Q Okay. Do you recall reading
20 literature from as far back as the '40s and '50s on
21 PCB health and safety matters?

22 A Yes.

23 Q Okay. Let me ask to have marked as
24 Papageorge Exhibit No. 1 a multipage document that
25 appears to be an excerpt of a larger document,

1 possibly a book, the first page has a page number of
2 1342 on it and Don D. Irish on the top, and it has a
3 Bates number of MONS 076165 through 170.

4 MR. HARCKHAM: Dale, was that all of
5 the document that was produced?

6 MR. HAUSMAN: Yes.

7 (Defendant's Deposition Exhibit
8 Papageorge 1 marked for identification by the court
9 reporter.)

10 Q (By Mr. Hausman) Mr. Papageorge, I
11 don't think you need to read the whole thing, I just
12 have a very few questions, and I'll point to one
13 passage.

14 First of all, do you recall ever
15 seeing a, a book or article by a Don D. Irish that
16 deals with, it appears to deal with cyclic
17 halogenated hydrocarbons?

18 A As I scan the document I see some
19 references to information here that I'm familiar
20 with. I don't at this point in time recall
21 specifically the name Irish, Don Irish. That
22 doesn't, I just don't remember that name.

23 Q Okay. So you don't recall seeing
24 either this passage or the book from which it's
25 taken before? That's what you have in front of you.

1 A It just doesn't look familiar to me.

2 Q Okay. If you look at the very first
3 page, the last paragraph which begins "Human
4 experience," do you see that paragraph?

5 A I see that.

6 Q Halfway through the paragraph there's
7 a sentence that reads, "Jones and Alden reported on
8 human cases working with chlorinated diphenyls.
9 They observed a typical acneform dermatitis among
10 workers handling this material." Do you see that
11 passage?

12 A I see that, yes.

13 Q Are chlorinated diphenyls the same as
14 chlorinated biphenyls?

15 A Yes.

16 Q Do you recall ever seeing a Jones and
17 Alden report on chlorinated diphenyls?

18 A I do not.

19 Q This condition that's described in
20 this document, the typical acne form dermatitis, are
21 you familiar with that condition being associated
22 with chlorinated diphenyls?

23 A I'm familiar with allegations made
24 that PCBs are associated with this skin condition.

25 Q Okay. Do you recall when you learned

1 of those allegations being made, what period in
2 time?

3 A As best I recall, it happened when I
4 was for sure at the Anniston Plant. For sure. I
5 believe I had heard some reference to this condition
6 because of another product that I was associated
7 with at the Krummrich Plant.

8 Q What was that product?

9 A That was chlorobenzenes. No, no.
10 It's nitrochlorobenzene. Wood treating chemicals.
11 And at that time there was some reference made to
12 the broad family of chlorinated hydrocarbons, and
13 there was a suggestion that the chlorinated
14 hydrocarbons Monsanto manufactured could fall into
15 that broad category. And that's the extent of my
16 memory, really. It was not a new subject, but I did
17 associate it with chlorinated hydrocarbons.

18 Q The Jones and Alden article report
19 that's referred to, if you see, there's a footnote
20 that appears to, it's a reference a date of 1936.
21 Were you aware, when you learned of these
22 allegations of acneform dermatitis, that they were
23 alleged as early as 1936?

24 MR. HARCKHAM: Objection, lack of
25 foundation.

1 A I don't remember the exact year, but I
2 do remember being tutored by the Medical Department
3 about chloracne before World War II period. That's
4 as close as I can get date-wise.

5 Q (By Mr. Hausman) Okay. Just to be
6 clear, before the World War II refers to when the
7 allegations were made or when you were tutored?

8 A No, that was, I was tutored in 1970
9 about the past.

10 Q Okay.

11 A And the reference to this chloracne
12 situation was described to me as occurring in the
13 early '40s, late '30s, some, I don't remember the
14 dates, but it was before World War II. At least
15 that's my memory. That was my first exposure to
16 someone dating that information.

17 Q All right. Okay. You used the word
18 "allegations" in describing the acneform dermatitis
19 or chloracne condition.

20 A Yes.

21 Q Are you aware of whether those
22 allegations have been proven to be true with regard
23 to PCBs?

24 MS. RUTTER: Objection to the form of
25 the question to the extent it asks a non-medical

1 person to form a medical conclusion.

2 MR. HAUSMAN: Fair enough.

3 MS. RUTTER: You can certainly ask him
4 questions based on his personal --

5 MR. HARCKHAM: Same objection.

6 Q (By Mr. Hausman) I don't even want to
7 know your conclusions. Let me reask the question.

8 Are you aware of any studies -- well,
9 let me see how I can ask that. Okay.

10 Let me ask, in your opinion, given
11 your experience, have you seen any studies that in
12 your opinion establish that chloracne is caused by
13 PCB exposure?

14 MR. HARCKHAM: Objection.

15 MS. RUTTER: I object to the overbroad
16 and vague form of the question and also to the
17 extent that it's calling for a medical opinion from
18 a non-medical person.

19 Q (By Mr. Hausman) I don't want you to
20 give a medical opinion, but I do want to know
21 whether you've seen anything in which you personally
22 would have formed that opinion.

23 A When you say medical report, are you
24 talking about formal report, or are you just
25 information that is available?

1 Q Any information, whether it be a
2 report or studies or anything like that.

3 A Any information? I was, during my
4 tutorial with the Medical Department in early 1970,
5 a reference was made to an incident that occurred at
6 the precursor company, before Monsanto bought that
7 facility, having an experience with chloracne
8 amongst its workers that were making PCBs and it was
9 traced to a poor quality benzene. That is the only
10 information I have regarding chloracne.

11 Q Okay. When you used the word
12 "allegation," do you have an opinion as to whether
13 those allegations are true or false?

14 MR. HARCKHAM: Objection, vague and
15 ambiguous. Lack of foundation.

16 A I have an opinion.

17 Q (By Mr. Hausman) And what is that
18 opinion?

19 A There is an allegation, there was a, a
20 coating system for cable in which they used a
21 mixture of chemicals called Halowax, and I
22 understood, as a result of my tutorial, that the
23 allegations initially included reference to the
24 presence of PCBs as being a cause. I was informed
25 that the information later developed that it was

1 the, a different chemical, not PCBs, that was the
2 cause of the skin condition.

3 Q And does that lead you to believe that
4 PCBs do not cause chloracne?

5 MS. RUTTER: Objection to the vague
6 and confusing form of the question to a non-medical
7 person.

8 A I have never seen symptoms amongst the
9 workers, I've never read anything to lead me to
10 believe otherwise, so I, I find it difficult to
11 associate chloracne with PCB exposure.

12 Q (By Mr. Hausman) Well, let me ask you
13 this. Have you read any -- let me strike that.

14 Have you read any reports in which the
15 medical community has concluded that PCBs do not
16 cause chloracne? I'm just asking if you've read any
17 reports.

18 A Medical community report, I have never
19 seen any such report.

20 Q Okay. All right. Let me ask you to
21 mark as Papageorge Exhibit No. 2 a multipage
22 document with the title General Information
23 Concerning the Handling of Aroclor 1254 by W.E.
24 Alexander, date, December 1, 1941, it has Bates
25 number MONS 060030 through 38.

1 (Defendant's Deposition Exhibit
2 Papageorge 2 marked for identification by the court
3 reporter.)

4 Q (By Mr. Hausman) Again, Mr.
5 Papageorge, if you could just briefly scan this
6 document, I'll have a very few questions, and I'll
7 point to, any passages to you that I have questions
8 about.

9 A I have scanned the report.

10 Q Okay. Do you recall ever seeing this
11 report before?

12 A I don't recall it.

13 Q All right. Do you know who W.E.
14 Alexander is or was?

15 A I think I remember Bill Alexander but
16 I have a hard time placing just under what
17 circumstances I met the man.

18 Q Do you recall him being employed by
19 Monsanto?

20 A Yes. As an engineer I think in
21 engineering, but I don't, I'm not certain.

22 Q Is Aroclor 1254 a PCB containing
23 fluid?

24 A Yes.

25 Q Okay. If you'd turn to the fifth page

1 of this document that has the number 2 on the top
2 with the heading Hazards, do you see that?

3 A I see that.

4 Q The first sentence reads, "The fumes
5 from Aroclor 1254 are quite obnoxious and are, when
6 inhaled excessively, dangerous and hazardous." Do
7 you see that?

8 A Yes.

9 Q Are you aware of what condition that
10 this refers to?

11 MR. HARCKHAM: Objection. I don't
12 understand your question.

13 Q (By Mr. Hausman) Do you understand
14 the question?

15 A Well, I'm puzzled because it does
16 refer to fumes and --

17 Q Okay.

18 A Is that the condition you're --

19 Q Yes. To your knowledge are, to your
20 knowledge of Aroclor 1254, are its fumes quite
21 obnoxious?

22 MR. HARCKHAM: Objection.

23 Q (By Mr. Hausman) If you know.

24 A Of course that depends on the density
25 of the fumes, and it's subjective in terms of what

1 is obnoxious to me may not be to you.

2 Q All right. Let me ask you this. Are
3 you aware of any hazards associated with the
4 breathing of Aroclor fumes?

5 A Yes.

6 Q And what are those hazards?

7 A The first symptom that would be
8 noticeable if an excess amount of these fumes are
9 inhaled would result in a coughing and chest pain
10 similar to a severe chest cold. I call that an
11 early warning symptom that the individual is
12 overexposed. Now, that varies from person to person
13 also. Some people can withstand it longer than
14 others.

15 Q I believe you used the term "excessive
16 exposure"?

17 A I'm sorry?

18 Q Did you use the term "excessive
19 exposure"?

20 A Yes.

21 Q Can you, is it possible to define what
22 you mean by that?

23 A One way to define it is to use the
24 ACGIH, which is the American Conference of
25 Industrial, or Governmental Industrial Hygienists.

1 They have a published, an exposure level from years
2 back as to what is considered an acceptable maximum
3 level in the workplace.

4 Q Do you know when they published that
5 exposure level?

6 A As best I recall, it was in the '50s.

7 Q And when they published it, do you
8 recall what form they published it in? Was it a
9 pamphlet or a book or anything else?

10 A I recall seeing a pamphlet, and I also
11 know that it's listed in the booklet which lists
12 many, many chemicals and the exposure levels that
13 are recommended.

14 Q Are there any other definitions of
15 "excessive exposure" that you would use, or is that
16 the primary definition?

17 MS. RUTTER: I would object to the
18 overbroad and vague form of the question.

19 MR. HARCKHAM: Same objection.

20 Q (By Mr. Hausman) I think you said one
21 way of characterizing excessive exposure is by
22 referring to those levels. Is there any other way
23 of characterizing --

24 A Yes, the other way would be the
25 employee developed this chest pain and discomfort.

1 That's a way to say, now, that's excessive for sure,
2 in spite of the numbers in this booklet.

3 Q Do you recall, again, when you first
4 learned of potential hazards from excessive
5 inhalation exposures of Aroclor 1254?

6 MR. HARCKHAM: Objection, vague and
7 ambiguous.

8 A As best I recall it was during the
9 period that I was at the Anniston Plant, that's
10 starting in 1965.

11 Q (By Mr. Hausman) Let me ask to be
12 marked as Exhibit No. 3 a one page document with the
13 date 14/12/49, which I take to mean December 14. It
14 appears to be from a W.H. Ritchie, R-i-t-c-h-i-e, it
15 appears to be to a Mr. N.G.H. Thomas, has a Bates
16 number of MONS 095207.

17 (Defendant's Deposition Exhibit
18 Papageorge 3 marked for identification by the court
19 reporter.)

20 A I have read the document.

21 Q (By Mr. Hausman) Have you ever seen
22 this document before, Mr. Papageorge?

23 A I'm sorry?

24 Q Have you ever seen this document
25 before?

1 A I recall it, yes.

2 Q Okay. What are the circumstances
3 under which you recall seeing this document?

4 A I believe as best I recall that this
5 was one of the documents shown to me when I had my
6 tutorial with the Medical Department in January and
7 February or so of 1970.

8 Q Is that when you became the Manager of
9 Environmental Control?

10 A Yes.

11 Q Do you recall any discussions about
12 this document or the matters described therein?

13 MS. RUTTER: Objection to the vague
14 form of the question. With, with whom?

15 Q (By Mr. Hausman) I can ask that
16 question, too. Well, do you recall who showed you
17 this document?

18 A I do.

19 Q Who was that?

20 A Elmer Wheeler, W-h-e-e-l-e-r.

21 Q And what was his position in January
22 of 1970?

23 A At that time he was the Assistant
24 Director of Monsanto's Medical Department.

25 Q Did Mr. Wheeler -- let me start again.

1 Do you recall any discussions with Mr.
2 Wheeler about this document?

3 A I, of course, don't recall the
4 specific words used, but the overall impression was
5 that these suggestions on clothing, rubber gloves
6 and ventilation and all were quite appropriate.

7 Q You see the second paragraph, the
8 first sentence reads, "Dr. Newman and myself are of
9 the opinion that the greatest danger lies in the
10 inhalation of vapors at high temperatures," and that
11 appears to refer to Aroclors. Do you recall
12 discussing dangers of inhalation of Aroclor vapors
13 with Mr. Wheeler? With Dr. Wheeler?

14 A Yes, it has to do along the lines with
15 this severe chest pain bit that I mentioned.

16 Q Okay. Do you know who W.H. Ritchie is
17 or was?

18 A I don't, no.

19 Q How about Dr. Newman?

20 A I had heard, I've never met Dr.
21 Newman. He was the Medical Director of Monsanto's
22 European facilities.

23 Q And just referring to the top, to
24 these other names, do you know who N.G.H. Thomas is
25 or was?

1 A No, I don't recall.

2 Q How about J.W. Barrett?

3 A Dr. Barrett was a chemist involved
4 with the research in the European operation.

5 Q And do you know who J.A. Gardner was?

6 A I don't remember Mr. Gardner, Dr.
7 Gardner.

8 Q Do you know whether this is a document
9 that was prepared by a Monsanto person or employee?

10 MR. HARCKHAM: Objection, lack of
11 foundation.

12 MR. HAUSMAN: If you know.

13 MS. RUTTER: I join in that objection.

14 A I don't know.

15 Q (By Mr. Hausman) Okay. Let me ask to
16 have marked as Exhibit 4?

17 MR. HARCKHAM: Right.

18 Q (By Mr. Hausman) A two page document
19 with a date December 11/51, it appears to be from
20 E. Mather to P.J.C. Haywood, H-a-y-w-o-o-d, Bates
21 numbers MONS 095205 through 206.

22 (Defendant's Deposition Exhibit
23 Papageorge 4 marked for identification by the court
24 reporter.)

25 (A brief recess was held at this

1 time.)

2 Q (By Mr. Hausman) Okay, Mr.

3 Papageorge, Exhibit 4 is a one page memorandum that
4 attaches either an excerpt or a whole article from a
5 chemist analyst. Do you have a recollection of
6 seeing either the memorandum or its attachment
7 before?

8 A Yes, I have seen this.

9 Q And do you recall what circumstances,
10 under what circumstances you saw it?

11 A It's part of this Medical Department
12 tutorial I mentioned earlier.

13 Q And this was from Mr. Wheeler?

14 A Yes.

15 Q Do you know -- let me start again.

16 Did Mr. Wheeler tell you whether the
17 Medical Department kept any files of documents
18 pertaining to toxicity of Aroclors?

19 A Oh, certainly.

20 Q He told you that?

21 A It was part of the medical library.

22 Q Did you have occasion to go into the
23 medical library?

24 A I'm sorry?

25 Q Did you have occasion to go into the

1 medical library?

2 A Oh, yes.

3 Q When you were Director of
4 Environmental Control or earlier?

5 A Since I was assigned Environmental
6 Control. Prior to that I had to request copies of
7 articles and so on by mail or phone.

8 Q And did you see a file of documents
9 such as Exhibit 4 in the medical library?

10 A Yes.

11 MR. HARCKHAM: Objection.

12 MS. RUTTER: You're talking about as
13 of 1970, Counsel?

14 Q (By Mr. Hausman) Yes, I am. Yes.

15 A Yes.

16 Q Do you know what that file was
17 entitled?

18 A As best as I recall, it was Aroclor
19 Toxicity Studies. That's my recollection.

20 Q And in the 1970 time frame, do you
21 know how big this file was? Was it several inches?

22 A I don't know how to describe, it was
23 several drawers of a metal four- or five-drawer
24 cabinet.

25 Q Do you know how long that file was

1 kept for? What the earliest date of that file was?

2 A No, I don't remember.

3 Q Did you have any responsibility when
4 you were Director of Environmental Control or in
5 your two other similar positions for sending
6 materials to that file?

7 A I would send any material that I felt
8 was relevant and of interest to the Medical
9 Department to either the Director or the Assistant
10 Director, and it was up to them to make a decision
11 what went into the file.

12 Q Who maintained this library in 1970?

13 A Who maintained it?

14 Q Yes.

15 A I don't understand.

16 Q Was that a Medical Department
17 function, or was it, was there a broad librarian?

18 A It's a Medical Department facility
19 manned by a librarian who reported to the Medical
20 Department.

21 Q And when you saw the document that's
22 Exhibit 4 in 1970, do you recall having any
23 discussions with Mr. Wheeler about its content?

24 A Yes.

25 Q Do you recall what those discussions

1 were?

2 A It's just shown to me as an example of
3 the kind of experiences that Monsanto had at its
4 plant, and also the interest shown by others in
5 exposure to the Aroclor vapors.

6 Q When you say, "interest shown by
7 others," who are you referring to?

8 A I'm particularly referring to this Mr.
9 Brown, who was with the City of St. Louis Department
10 of Public Welfare, that's an example. There are
11 others.

12 Q All right. Let me ask to have marked
13 as Exhibit No. 5 a one page document dated December
14 17/51 from E. Mather to Mr. P.J.C. Haywood, Bates
15 number MONS 095204.

16 (Defendant's Deposition Exhibit
17 Papageorge 5 marked for identification by the court
18 reporter.)

19 A I have read the memorandum.

20 Q (By Mr. Hausman) Okay. Do you recall
21 ever seeing this document before?

22 A I don't recall the document. I
23 recognize some of the information in there.

24 Q What information do you recognize?

25 A Well, that first paragraph seems to be

1 referring to the incident I mentioned earlier about
2 Swan Chemical Company's experience that occurred in
3 1933.

4 Q And where did you learn of that
5 incident, if you recall?

6 A It was during this tutorial. I don't
7 know if it came up with a document in front of me or
8 whether it was just passed on to me.

9 Q All right. The second paragraph
10 reads, "A little browsing into the literature
11 reveals quite a history of skin troubles and liver
12 troubles (including some fatal cases) attributed to
13 heavy exposure to chlorinated diphenyls."

14 Did you discuss in this tutorial
15 potential liver damages from PCBs?

16 A Yes.

17 Q Do you recall what those discussions
18 were?

19 A I was told that if exposure to PCBs
20 continued to be excessive, it is very possible that
21 the liver is affected, and if the exposure
22 continues, that liver reaches the point where it
23 cannot heal itself, and that could prove to be
24 fatal.

25 Q Do you recall learning of any studies

1 that were done of the potential liver damage from
2 PCBs?

3 A I'm not aware of any studies.

4 Q Okay.

5 MS. RUTTER: I'm going to belatedly
6 object, objection to the overbroad vague form of the
7 question.

8 Q (By Mr. Hausman) When you learned of
9 potential liver troubles from PCBs?

10 A Yes.

11 Q Do you recall learning whether those
12 liver troubles were the result of any one type of
13 exposure, be it breathing, skin contact, or
14 ingestion?

15 MR. HARCKHAM: Objection.

16 A No distinction was made during our
17 discussion.

18 Q (By Mr. Hausman) Do you recall
19 learning at any later point of any distinction?

20 A No.

21 Q Okay. Let me ask to have marked as
22 Exhibit 6 a one page document dated February 12,
23 1954, from R. Emmet Kelly, M.D. to Dr. H.R. Newman,
24 Bates number MONS 095193.

25 (Defendant's Deposition Exhibit

1 Papageorge 6 marked for identification by the court
2 reporter.)

3 A I've read the document.

4 Q (By Mr. Hausman) Okay. Do you recall
5 seeing this document before?

6 A Yes.

7 Q Is this one of the documents that you
8 saw during the 1970 tutorial?

9 A Yes.

10 Q Would you tell me who R. Emmet Kelly
11 was?

12 A He was at that time the Monsanto
13 Corporate Medical Director.

14 Q And when you're saying "at that time,"
15 do you mean 1970 or 1954?

16 A 1954, the date of this memorandum.

17 Q The date of the memo, all right. Was
18 he still at Monsanto in 1970?

19 A Yes.

20 Q And what was his position then? What
21 was his position then?

22 A Still Corporate Medical Director.

23 Q Okay, the first paragraph, the first
24 three sentence reads, "We do not know what the
25 maximum allowable concentration of Aroclor is. One

1 milligram per cubic meter has been set up. We have
2 run animals for about 60 days at 7 times this and
3 found some liver damage."

4 Do you recall in 1970 learning of
5 these studies that were done on or about 1954?

6 A Yes.

7 Q Earlier I showed you some documents
8 that discussed potential hazards from breathing
9 Aroclor fumes?

10 A I think I remember which.

11 Q Based on your understanding of that
12 potential hazard, is the concern there liver damage
13 or something else or both?

14 MR. HARCKHAM: Objection, lack of
15 foundation.

16 MS. RUTTER: Object to the overbroad
17 and vague form of the question to a non-medical
18 person, but subject to those objections, Mr.
19 Papageorge, you may respond if you understand the
20 question.

21 Q (By Mr. Hausman) Did you understand
22 the question?

23 A I think I do. You mentioned a liver
24 damage as being the real concern, actually the
25 concern is for symptoms that appear before that

1 liver is damaged. The very fact of the individual
2 that breathed too many fumes is experiencing
3 discomfort, can't breathe, he's coughing, you don't
4 want that either.

5 Q Okay.

6 A So, and an individual who has the red
7 skin from getting too much on his skin, we don't
8 want that. And that's a long, a long way to go
9 before you get to the liver damage problem.

10 Q All right. Thank you.

11 Now, based on the documents that we've
12 seen so far, is it fair to say that in 1970 in this
13 tutorial, you learned of three alleged hazards from
14 PCBs, one being skin, either chloracne or problems;
15 two being this coughing that you talked about as far
16 as inhalation goes; and three being liver damage; is
17 that correct?

18 A I knew of those before, when I was
19 down in Anniston.

20 Q Okay. Were there any other hazards
21 besides those three that you either knew of at
22 Anniston or you either learned of in 1970 resulting
23 from PCB exposures?

24 A I can't think of any.

25 Q So those are the three main ones?

1 A That's it.

2 Q Let me ask to be marked as Exhibit 7
3 an apparent excerpt of a book that was produced by
4 Monsanto, the title appears to be The Chemistry of
5 Industrial Toxicology, it has Bates numbers of MONS
6 076158 through 161.

7 (Defendant's Deposition Exhibit
8 Papageorge 7 marked for identification by the court
9 reporter.)

10 Q (By Mr. Hausman) And Mr. Papageorge,
11 I don't think you have to read this, very simply I
12 have one question, maybe two questions. Are you
13 familiar with a book entitled The Chemistry of
14 Industrial Toxicology?

15 A This is, can you help me, sir, is this
16 the Sax manual? Dr. Sax?

17 Q That I don't know, because this is how
18 it was produced, and actually, I don't believe it
19 is.

20 A I'm not familiar with a book by the
21 title you just mentioned.

22 Q Okay.

23 A But I am familiar with the Sax
24 reference book on toxicology.

25 Q Okay. Let me show you that. Let me

1 ask that marked as Exhibit No. 8, certain pages from
2 a book entitled Dangerous Properties of Industrial
3 Materials by N. Irving Sax, including the cover page
4 and certain other pages. It does not have a Bates
5 number because it was not produced by Monsanto.
6 It's from a, from a third source.

7 (Defendant's Deposition Exhibit
8 Papageorge 8 marked for identification by the court
9 reporter.)

10 Q (By Mr. Hausman) Mr. Papageorge, does
11 this appear to be an excerpt of the Sax manual that
12 you just mentioned?

13 MR. HARCKHAM: Objection, lack of
14 foundation, and I further object to you using a,
15 bits and pieces of a document like this and asking
16 the witness if it's an excerpt.

17 Q (By Mr. Hausman) Okay. Well, if you
18 look at the first page, then, let's go through it
19 from that. Are you familiar with a book entitled
20 Dangerous Properties of Industrial Materials by N.
21 Irving Sax?

22 A I am.

23 Q And is that the book that you were
24 referring to in your prior testimony?

25 A Yes.

1 Q How are you familiar with that book?

2 A In my involvement with many Monsanto
3 chemicals, I found this to be quite helpful as a
4 reference book. At least as a starting point.

5 Q Do you recall when your earliest
6 reference to the Sax book was? What year?

7 A About, during the tutorial we talked
8 about, 1970.

9 Q So not before 1970?

10 A That's true.

11 Q All right. Do you know whether this
12 book is kept in the Monsanto medical library?

13 MR. HARCKHAM: Are you asking him now,
14 if it's kept there now?

15 Q (By Mr. Hausman) I'll ask in 1970
16 when you first saw it.

17 A 1970, at least one volume was there.
18 There were many around.

19 Q Many around, all through Monsanto?

20 A All the desks, medical personnel, they
21 all had copies.

22 Q Do you have any knowledge of when the
23 earliest time it was that employees of Monsanto had
24 copies of this?

25 A Oh, I don't know that.

1 Q Okay. Let me ask to have marked as
2 Exhibit No. 8, No. 9, excuse me, a one page document
3 produced by Reynolds, not by Monsanto, it's on
4 Monsanto Chemical Company letterhead, it is a single
5 page, appears to be an incomplete document dated
6 January 30, 1959. The author, or the recipient is
7 illegible, it appears to be Mr. D.A., the last name
8 is illegible, and it refers to that person as
9 Purchasing Agent, and it has a Bates number of RLD
10 0770380.

11 (Defendant's Deposition Exhibit
12 Papageorge 9 marked for identification by the court
13 reporter.)

14 Q (By Mr. Hausman) Mr. Papageorge, I'll
15 represent to you that this is the only page of this
16 document that's been produced. The first page, in
17 the first paragraph refers to a shipment of Aroclor
18 1248. Do you see that?

19 A I see that.

20 Q Okay. Now, if you look at the bottom
21 of the page, the very last sentence at least begins,
22 "I am sure that your people will be interested in
23 the attached information covering dermatological and
24 toxicological characteristics of handling," and then
25 it ends.

1 I want to be very clear, I want you to
2 be very clear on what I'm asking here, and by that I
3 want to know what your knowledge is, and if your
4 answer is I don't know, then that's a fair answer,
5 okay?

6 On or about January 30, 1959, did
7 Monsanto have a general practice of advising its
8 customers of dermatological and toxicological
9 characteristics of Aroclors?

10 A As a general rule, yes.

11 Q And how do you know that?

12 A Well, a good example is the brochures
13 that were in print at the time.

14 Q Around 1959?

15 A '59, there are sections with various
16 titles, but the reference was to the proper way to
17 handle the material and respect it.

18 Q Okay.

19 A We cannot forget that the labels on
20 the products referred to don't expose to, don't have
21 prolonged exposure to fumes, don't get it on your
22 skin, these kinds of warnings.

23 Q If you know, again, in this 1959
24 period, did Monsanto as a general practice advise
25 purchasers of Aroclors of potential skin hazards

1 from, from Aroclors?

2 A Can you help me with your expression
3 "skin hazards"? You mean --

4 Q Sure. We talked earlier about
5 allegations of chloracne from PCBs. Do you know
6 whether Monsanto, in the 1959 time frame, as a
7 practice advised its customers of those allegations?

8 A I don't recall any specifics of that
9 type. The advice was always one of preventing the
10 exposure in the first place.

11 Q If you know, in 1959, did Monsanto
12 provide its customers of Aroclors with any reports
13 or analyses of the toxicology or dermatological
14 effects of Aroclors?

15 MR. HARCKHAM: Objection.

16 A As I understood it, and understand to
17 this day, if a request was made to Monsanto for that
18 kind of information, it would be relayed to
19 Monsanto's Medical Department, and it was a
20 situation where either a medical doctor was talking
21 to a medical doctor or industrial hygienist was
22 talking to industrial hygienist and the appropriate
23 documents would be forwarded if requested.

24 So it was on a case by case basis that
25 that happened.

1 Q (By Mr. Hausman) Okay. Could you
2 refer back to Exhibit No. 2? That's the General
3 Information Concerning the Handling of Aroclor 1252?

4 A I have it.

5 Q Okay. Do you have any knowledge
6 of whether this document is the type of document
7 that --

8 A I'm sorry?

9 Q Do you have any knowledge of whether
10 this document is the type of document that Monsanto
11 would send on to its customers?

12 MR. HARCKHAM: Objection. Let me just
13 expand on my objection for a minute, please. I
14 think in fairness you ought to point him to the
15 distribution page on this, just, the second page of
16 the document.

17 Q (By Mr. Hausman) Sure. Beyond what
18 the people that are indicated as distributees on the
19 second page, do you have any knowledge of whether
20 Monsanto had a practice of distributing reports like
21 this to its customers at any time?

22 MS. RUTTER: At any time, Counsel?
23 That's your question?

24 MR. HARCKHAM: I still object.

25 Q (By Mr. Hausman) Okay. Let's talk

1 about in the time period of 1940 to 1960. Again,
2 I'm asking for your knowledge, that's all I'm asking
3 for.

4 MS. RUTTER: I'll object to the
5 overbroad and vague form of the question, lack of
6 foundation.

7 MR. HARCKHAM: Right. That's mine,
8 too, as well.

9 A My understanding, not because I was
10 there at that point in time, but the kinds of
11 information that we are looking at now in this
12 exhibit were very commonly included in other
13 informational pamphlets, brochures and the like.
14 Marketing people were given a supply of those and
15 they would drop them off as they visit their
16 customers or mail it to them when requested. So
17 that information was very freely distributed.

18 Q (By Mr. Hausman) Okay. Thank you.
19 Let me ask to have marked as Exhibit No. 10 a
20 multipage document entitled Physical Properties of
21 the Aroclors, appears to be prepared by Monsanto
22 Chemicals of Quality, St. Louis. And it does not
23 appear to have a date on it.

24 (Defendant's Deposition Exhibit
25 Papageorge 10 marked for identification by the court

1 reporter.)

2 A I have scanned the document.

3 Q (By Mr. Hausman) Do you recall seeing
4 this document before?

5 A Yes.

6 Q Under what circumstances?

7 A I don't recall the specific
8 circumstances. This is --

9 Q Is this a brochure?

10 A It's an early brochure, yes.

11 Q And when you say "early," can you give
12 an estimate of what time period this was prepared?

13 A Oh, golly, I was looking for the date
14 --

15 MR. HARCKHAM: I'm just going to
16 object, lack of foundation.

17 A I would suggest the '40s.

18 Q (By Mr. Hausman) Why do you say that?

19 A From the Monsanto logo that existed at
20 that point in time.

21 Q Do you know when that logo was
22 discontinued?

23 A I'm sorry?

24 Q Was that logo discontinued?

25 A It's, it's changed in appearance

1 through the years.

2 Q All right.

3 A And it went through various changes.

4 Q And just for the, so the record is
5 clear, you're referring to the oval logo with
6 "Monsanto" in the center of it; is that correct?
7 About two-thirds of the way down the page?

8 A It's the oval as well as the line
9 below that says, "Manufactured by" with "Monsanto"
10 with those bars across "Monsanto Chemical Company."

11 Q Okay.

12 A That was typical in the '30s and '40s.

13 Q Okay. Let me ask to have marked as
14 Exhibit No. 11 --

15 MR. HARCKHAM: Let me interrupt you
16 for a second. It's 12:35, you want to think about
17 breaking for lunch?

18 MR. HAUSMAN: Yeah, actually once I
19 get past this document, that'll pretty much be a
20 good breaking point.

21 MR. HARCKHAM: All right.

22 Q (By Mr. Hausman) Exhibit 11 is a
23 multipage document with a front page stating
24 Monsanto Aroclor 1248, and it does not appear to
25 have a date on it, and that's Bates numbers from

1 MONS 079962 through 079997.

2 (Defendant's Deposition Exhibit
3 Papageorge 11 marked for identification by the court
4 reporter.)

5 A I have scanned the document.

6 Q (By Mr. Hausman) Thank you. Do you
7 recognize this document, Mr. Papageorge?

8 A Yes.

9 Q And is this also a brochure that
10 Monsanto provided to its customers?

11 A This is a brochure, yes.

12 Q Is this the type of brochure that as a
13 general practice Monsanto would give to its
14 customers?

15 MR. HARCKHAM: Objection, lack of
16 foundation.

17 A Oh, I wouldn't call it general. This
18 is pretty specific to this particular product.

19 Q (By Mr. Hausman) Do you know whether
20 Monsanto as a general practice would provide this
21 brochure to its customers of Aroclor 1248?

22 A Yes.

23 Q Again, this document does not appear
24 to have a date on it. Is there anything in the
25 document from which you can make an estimation of

1 the date that this was prepared?

2 MR. HARCKHAM: If you look there's a
3 bibliography, just to speed things up.

4 MR. HAUSMAN: On page 995.

5 MR. HARCKHAM: Right.

6 MR. HAUSMAN: Yeah. It's the third
7 from the last page, I believe, there's a
8 bibliography which provides some dates.

9 A I see that, yeah.

10 Q (By Mr. Hausman) From, from that or
11 any other indications, possibly the logo, is there
12 any way of telling from this document what the
13 approximate date was?

14 A Yeah, the middle '50s is what I would
15 say, yes.

16 Q And why do you say that?

17 A Well, first of all, this logo now
18 reflects the '50s.

19 Q That's the logo on the first page?

20 A And then this page 079995 where the
21 literature is cited, the first citation there is a
22 Applications Bulletin dated 1954. So this document
23 has to be at least that vintage, 1954 or later.

24 Q Thank you. Why don't we go off the
25 record.

1 (A recess was held for lunch at this
2 time.)

3 Q (By Mr. Hausman) Okay. Let me ask to
4 have marked as Exhibit No. 12 a one page document,
5 in larger print entitled Therminol FR, Safety of
6 Handling, Bates number MONS 076584.

7 (Defendant's Deposition Exhibit
8 Papageorge 12 marked for identification by the court
9 reporter.)

10 A I have read the document.

11 Q (By Mr. Hausman) Mr. Papageorge, do
12 you recognize this document?

13 A I believe I do.

14 Q Do you recall what circumstances,
15 under what circumstances you've seen this document
16 before?

17 A It appears to me to be a page out of a
18 Monsanto brochure relating to Therminols.

19 Q Okay. Is there a difference between
20 Therminols and Aroclors?

21 A You mean chemically or title-wise?

22 Q Chemically.

23 A Chemically, some of the Aroclors are
24 also called Therminols.

25 Q All right. Are Therminols used for

1 heat transfer media?

2 A Yes.

3 Q I've seen numbers on Aroclors such as
4 1248 and 1252, is there a name for those numbers? I
5 just want to make sure we're talking about the same
6 thing.

7 A Well, there is no name for the numbers
8 except that the numbers do indicate what type of
9 mixture is in that particular Aroclor product.

10 Q All right. Is it correct that the
11 last two digits of those numbers indicates the
12 percentage of chlorine? Is that correct?

13 A Yes.

14 Q So 1252 would be 52 percent chlorine?

15 A If there were a 52. It's actually 54.

16 Q 54.

17 A That means 54 percent by weight is
18 chlorine.

19 Q Do the Therminols have a specific
20 weight by chlorine?

21 A Well, the particular Aroclor used in
22 that particular Therminol is designated by that four
23 digit number we talked about.

24 Q So the Therminols have different
25 percentage weights?

1 A Yes. Just like the Aroclors.

2 Q All right. I guess what I'm trying to
3 understand is, is this. Well, let me ask a
4 question.

5 Did Monsanto sell products called both
6 Aroclors and Therminols?

7 A Yes.

8 Q Okay. Is there a reason for those
9 difference in names between Aroclor and Therminols?

10 A I think there's a reason, yes. The
11 use of the word "Therminol" is used to imply that
12 this particular liquid is used in thermal systems.
13 As distinguished from the word "Aroclor," which is a
14 product that can be used in many, many different
15 ways.

16 Q Okay. Is "Aroclor" a broader term for
17 a broader category of substances?

18 A Oh, yes. It covers many, many
19 different products.

20 Q Okay. Back to Exhibit 12, are there
21 any indications on this document that would enable
22 you to make an estimate of when it was written?

23 A No, there are no indications.

24 Q Okay. Let me ask to have marked as
25 Exhibit 13 a two page document, Monsanto Company

1 indicated at the top, the title is Therminol FR-0,
2 Bates number MONS 064725 through 726 and it has the
3 date indicated on the second page of August 17,
4 1966.

5 (Defendant's Deposition Exhibit
6 Papageorge 13 marked for identification by the court
7 reporter.)

8 A I have read the document.

9 Q (By Mr. Hausman) Do you recognize
10 this document?

11 A Yes.

12 Q And under what circumstances have you
13 seen this document before?

14 A I don't remember the specifics. This
15 is typical of the kinds of statements that the
16 Medical Department would issue on Monsanto products.

17 Q Do you know whether this statement as
18 a practice would be distributed to customers?

19 MR. HARCKHAM: Objection. I don't
20 understand, for one thing, I don't know what time
21 period you're talking about.

22 Q (By Mr. Hausman) At any time after
23 its preparation.

24 A Yes.

25 Q And why do you say that?

1 A That was the intent of preparing it in
2 the first place.

3 Q To distribute to customers?

4 A Yes, for in, Monsanto's personal or in
5 house use and to distribute to any interested
6 parties, whether they be current customers, future
7 customers, or regulatory agents, whoever.

8 Q Okay. Does the fact that it includes
9 a Monsanto Company legend with an address indicate
10 that it's intended for outside distribution?

11 MR. HARCKHAM: Objection, lack of
12 foundation.

13 Q (By Mr. Hausman) If you know.

14 A Not necessarily. It could be internal
15 also.

16 Q If you could look at the last
17 paragraph of the first page, the last two sentences,
18 it reads, "In heat transfer installations, the fluid
19 must be used in a closed system free from leaks with
20 the expansion tank vented to the outdoors.
21 Accordingly, there should be little or no
22 opportunity for workers to come in contact with the
23 vapors."

24 To your knowledge did Monsanto -- let
25 me start this over, let's put this in a time period.

1 Before the date of this document,
2 August 17, 1966, do you know whether Monsanto had a
3 practice of advising its customers that heat
4 transfer installations had to have closed systems
5 free from leaks?

6 MR. HARCKHAM: Objection, lack of
7 foundation.

8 Q (By Mr. Hausman) Again, if you have
9 that knowledge.

10 A Yes, that was the intent, to inform
11 customers on the need to have a leakproof system.

12 Q Okay. And under that intent, do you
13 know what hazards or dangers were anticipated, if
14 any?

15 MR. HARCKHAM: Objection, lack of
16 foundation.

17 A Well, the degree of hazard and danger,
18 of course, is related to the amount of material, to
19 the time of exposure, the number of people that
20 could be exposed, and that certainly was an
21 intention to minimize all that. In fact, not only
22 minimize, completely eliminate. The other intent,
23 of course, was to keep it from getting into the
24 sewer and leaving the premises.

25 Q (By Mr. Hausman) When you say the

1 amount of material was a factor, does that mean if a
2 system used more, or a large degree of HTM fluid,
3 that ought to be more important to prevent leaks?

4 MR. HARCKHAM: Objection, vague and
5 ambiguous.

6 A Well, I don't think it has anything so
7 much to do with the amount of liquid in a system,
8 it's the amount that is leaving the system
9 unintentionally that's critical.

10 Q (By Mr. Hausman) Okay. When you say
11 that, I believe you said it's the intent to advise
12 customers to prevent against leaks; that a fair
13 characterization?

14 A Yes.

15 Q Where did you learn of that intent?
16 Or in other words, what's the basis of your saying
17 that that's the intent?

18 A Gee, I don't know whether I can
19 describe it. This is, this is so common to all
20 Monsanto products, it's just not unique just to
21 Therminols, it's based just on the need to operate
22 in what I'm going to call a professional kind of
23 manner and maintain the equipment, keep the place
24 clean, I don't know how else to describe it.

25 Q Let me ask to have marked as Exhibit

1 14 a two page document dated July 18, 1969, with
2 Monsanto named at the top titled Toxicity and Safe
3 Handling, Therminol FR-1. It does not appear to
4 have a date, it has a Bates numbers MONS 071021
5 through 022.

6 (Defendant's Deposition Exhibit
7 Papageorge 14 marked for identification by the court
8 reporter.)

9 Q (By Mr. Hausman) It does have a date,
10 July 18, 1969.

11 A I have read the exhibit.

12 Q Do you recognize this document?

13 A Yes, I do.

14 Q And under what circumstances do you
15 recall seeing this document before?

16 A I don't recall a specific incident.
17 This is another example of the kind of information
18 put out by the Medical Director of Monsanto
19 referring to, in this case, a specific Therminol.

20 Q Okay. And would this document also be
21 intended for distribution to others, including
22 customers?

23 A Right.

24 MR. HARCKHAM: Objection, lack of
25 foundation.

1 Q (By Mr. Hausman) Is there a
2 difference between a Therminol FR-0 that's referred
3 to in Exhibit 13 and Therminol FR-1 that's referred
4 to in Exhibit 14?

5 A Different Aroclors are involved in
6 making each of these Therminols.

7 Q Do each of those correspond with a
8 1200 number?

9 A Well, the Therminol FR-1 is Aroclor
10 1242 if my memory serves me right.

11 Q Okay.

12 A FR-0, as I remember, is a blend, I
13 hope I remember this correctly, it's Aroclor 1254
14 plus tri- and tetrachlorobenzene. It's a, benzene
15 is added to thin it out a bit.

16 Q Is it correct that tri- and
17 tetrachlorobenzene are not PCBs?

18 A That's correct. That's a chlorinated
19 benzene, not a PCB.

20 Q Okay. So your recollection is that
21 Therminol FR-0 had a higher chlorine percentage than
22 FR-1; is that right?

23 A The Aroclor ingredient had a higher,
24 but I have not calculated the total chlorine. That
25 one associated with the benzene and the chlorine

1 associated with the biphenyl, I have not calculated
2 the total chlorine.

3 Q When you say you haven't calculated
4 the total chlorine, what are you referring to there?

5 A Well, one can sit down, if you're
6 interested in a number, and by the molecular weight
7 or atomic weight of each of the carbons and
8 hydrogens and chlorine, you can calculate what
9 percent by weight a mixture of these would show.

10 Q Okay. You can set that aside. Let me
11 ask to have marked as Exhibit 14?

12 MR. HARCKHAM: 15.

13 MR. HAUSMAN: 15, my apology, a six
14 page document, appears to be authored by W.B. Brown
15 with a date of, indicated as 26.11.54, which appears
16 to be November 26 of 1954, Bates numbers of MONS
17 095218 through 223.

18 (Defendant's Deposition Exhibit
19 Papageorge 15 marked for identification by the court
20 reporter.)

21 Q (By Mr. Hausman) Mr. Papageorge,
22 before you look through this whole document, I'm
23 going to have questions just on paragraph 3 of the
24 second page. But I think you should also quickly
25 look through the document to familiarize yourself

1 with it.

2 A I have scanned the exhibit.

3 Q Do you recognize this document?

4 A I do not recognize it.

5 Q Okay. Do you know who W.B. Brown is
6 or was?

7 A I, I don't recognize him.

8 Q Okay. In paragraph 3 of page 2 refers
9 to a Dr. Benignus or Benignus?

10 A Yeah, I see that.

11 Q Do you know him?

12 A I know Paul, yes.

13 Q Do you know if he's still alive?

14 A I believe he is.

15 Q What was his position in 1954?

16 A In 1954 Paul Benignus was a member of
17 Monsanto's Research Department studying PCBs and
18 applications of PCBs.

19 Q To your awareness is he retired today?

20 A I'm sorry?

21 Q Is he retired at this point in time?

22 A Oh, yes. Yes.

23 Q Do you know how old he is?

24 A In his 80s.

25 Q The last sentence read, "Dr. Benignus

1 keeps a careful check on sales of Aroclor and if the
2 replacement rate is high he has the situation
3 investigated."

4 Have you been aware of any such
5 practice, to monitor the amount of replacement of
6 Aroclors?

7 A Yes.

8 Q Is that something that Monsanto did as
9 a general practice?

10 A That is a general practice, yes.

11 Q Including in 1954?

12 A Yes.

13 MR. HARCKHAM: Let me belatedly object
14 on foundation grounds.

15 Q (By Mr. Hausman) That was actually my
16 next question. And how do you know that to be a
17 fact?

18 A I, what I'm going to call normal
19 communications with marketing people, shipping
20 people, and we had meetings where they discussed,
21 "Boy, the sales to company ABC are skyrocketing, we
22 got to look into that," and then they come back
23 later and say, "They've got a new system going," or,
24 "They drained their system," or, "They had an
25 accident," depending on what they find out.

1 Q Okay. Do you know what was done as a
2 practice if it was determined that a company had a
3 leaking HTM system? Heat transfer system?

4 MS. RUTTER: Objection to the
5 overbroad and vague form of the question.

6 MR. HARCKHAM: Objection.

7 Q (By Mr. Hausman) Okay, let me, let me
8 restate it.

9 Did Monsanto have any practices of
10 following up if, following up with a customer if the
11 replacement rate was determined to be high?

12 A Yes, they had a practice.

13 Q And what did that practice entail?

14 MR. HARCKHAM: Objection, lack of
15 foundation, and also object because there's no time
16 frame.

17 MS. RUTTER: I join.

18 Q (By Mr. Hausman) Why don't we start
19 in 1954, and that's if you know. Let's be clear.

20 A It was a practice where an unusual
21 amount of material was being delivered, shipped, the
22 field salesman would be asked to drop by and discuss
23 the matter. Sometimes those visits would result in
24 some information relating to, like I said earlier,
25 either a new system or a drain and fill of a system

1 or an accident, I can't think of any other examples.

2 And the salesman would report that
3 back to his supervisor, in turn it would get back to
4 the Director of the Business Group. If he felt that
5 the customer wasn't going to take corrective action,
6 he'd get involved and call somebody, the customer's
7 home office, for example. That kind of dialogue
8 would take place on occasion.

9 MR. HARCKHAM: I didn't mean to
10 interrupt you, I'm sorry. Are you done?

11 THE WITNESS: I'm done.

12 MR. HARCKHAM: I just want to make
13 clear for the record that I have a continuing
14 objection on the record on a foundation basis to
15 this line of questions.

16 Q (By Mr. Hausman) Yeah, and the
17 process you just described, how do you know that, or
18 how did you obtain that knowledge?

19 A It would come up in discussions with
20 the marketing people. We would have, marketing
21 salesmen would come in and we'd have seminars and
22 meetings, this would come up as a way that they
23 functioned out in the field. Some of them would
24 describe their successes and some would describe
25 their, their failures, the customer wouldn't let

1 them in the plant, they wouldn't share any
2 information with them, so I couldn't help but pick
3 it up.

4 Q And you were present at these
5 discussions and seminars?

6 A I would be, well, because I was part
7 of the program. And I had my information to give to
8 them and they in turn would give me theirs.

9 Q You say you were part of the program,
10 what program were you referring to?

11 A I was involved predominantly with
12 marketing people after 1970. Prior to that, the
13 meeting with groups of marketing people was not as
14 frequent. We would have meetings, say, at the
15 Anniston Plant. I would be the host and we'd have
16 30 salesmen show up and we'd have a two or three day
17 meeting. Then I would be involved. But that
18 wouldn't happen too often.

19 Q And just to be clear, as you learned
20 of these procedures to let's say monitor these
21 heated exchange systems, did you learn that those
22 procedures were in place as early as 1954?

23 A Yes.

24 Q And did you also learn that those
25 procedures continued from 1954, say, to 1970?

1 A Yes.

2 Q All right. Okay. Let me ask to have
3 marked as Exhibit 16 a multipage document entitled
4 A Guide to Accumulation and Shipment of Waste
5 Askarel Fluids, no apparent date, with a Bates
6 number of MONS 074772.

7 (Defendant's Deposition Exhibit
8 Papageorge 16 marked for identification by the court
9 reporter.)

10 A I have read the, or scanned the
11 exhibit.

12 Q (By Mr. Hausman) Thank you. Do you
13 recognize this document?

14 A Yes, I do.

15 Q Okay. And under what circumstances
16 have you seen this before?

17 A In my assignment as Manager of
18 Environmental Control, Environmental Protection, I
19 was in a position where I was consulted on attempts
20 to put in writing the proper handling of PCB
21 containing materials. This was prepared by the,
22 this was prepared by Monsanto people in the group
23 responsible for the marketing of dielectric fluids.

24 Q And dielectric fluids are different
25 from heat exchange fluids?

1 A Chemically not necessarily. Some of
2 them are identical chemically. Some of the
3 dielectric fluids are blends with other ingredients
4 present.

5 Q Is "askarel" a term that Monsanto used
6 to label these dielectric fluids?

7 A No, "askarel" is a term used by the
8 electrical equipment manufacturers who used fire
9 resistant fluids in their equipment. So in a way,
10 "askarel" is a generic expression for fire resistant
11 dielectric fluids.

12 Q Did Monsanto have brand names for
13 askarels?

14 A No.

15 Q So did Monsanto also refer to them as
16 askarels as they sold them?

17 A On occasion, yes. But generally we
18 would refer to them under the trademark which
19 reflected the particular recipe as ordered by the
20 customer. Like Pyranol was a General Electric name.
21 Inerteen was a Westinghouse name, and there were
22 several others.

23 Q Did Monsanto itself have any
24 trademarks for any askarels?

25 A No.

1 Q Did Monsanto sell dielectric fluids
2 that had PCBs?

3 A Yes.

4 Q Was Exhibit 16 something that was
5 intended to be distributed to customers?

6 A I'm sorry?

7 Q Sure. Let me restate that. Was
8 Exhibit 16, this document, something that was
9 intended by Monsanto to be distributed to customers?

10 A It was intended to be so, yes.

11 Q Okay. And can you give me an
12 estimate, if possible, as to the approximate time
13 frame in which this document was generated?

14 A It refers to a document available from
15 the American National Standards Institute, and that
16 document went into print in 1974. So it would have
17 to be shortly thereafter.

18 Q Thank you. I'm going to ask to have
19 marked as Exhibit 17, I believe, a multipage
20 document entitled Presentation to Field Sales,
21 Personal and Confidential, has a Bates number of
22 MONS 058519 through 528, 528, excuse me, and no
23 apparent date.

24 (Defendant's Deposition Exhibit
25 Papageorge 17 marked for identification by the court

1 reporter.)

2 A I have scanned the exhibit.

3 Q (By Mr. Hausman) Do you recognize
4 this document, sir?

5 A Yes, I do.

6 Q And under what circumstances do you
7 recall seeing this document before?

8 A I saw this document, as best I
9 remember, belatedly, after a letter to the customers
10 was sent. I forget the exact circumstances, but I
11 saw a copy of this presentation after the fact,
12 after the presentation was made. I would suggest
13 that this happened about March or April of 1970.

14 Q And when you saw it, you were the
15 Manager of Environmental Control?

16 A Yes.

17 Q Did you have any role in the
18 preparation of this document?

19 A No. Otherwise I would have seen it
20 earlier.

21 Q Sure. Do you know who prepared the
22 document?

23 A I'm not certain.

24 Q Okay. If you refer to the third page
25 of this document?

1 A I have it.

2 Q The second paragraph reads, "Let me
3 summarize what Monsanto's letter says: No. 1, Its
4 primary function is to alert customers to a
5 potential environmental pollution problem."

6 Do you know what the phrase "potential
7 environmental pollution problem" refers to?

8 MR. HARCKHAM: Objection, lack of
9 foundation.

10 MS. RUTTER: I join.

11 MR. HARCKHAM: We have the letter, you
12 might want to show him the letter.

13 Q (By Mr. Hausman) All right. Do you
14 know what that phrase refers to?

15 A The reference to "potential" had to do
16 with effect on the environment as distinguished from
17 presence in the environment, and it was potential at
18 the time because there was no information to clearly
19 define what is going on out in the environment with
20 PCBs present.

21 Q Is there any specific event that led
22 Monsanto to take the action of advising its
23 customers of a potential environmental pollution
24 problem?

25 MR. HARCKHAM: Objection, because I

1 don't know what you're referring to.

2 Q (By Mr. Hausman) Do you understand
3 the question?

4 A I didn't hear a key word at the
5 beginning.

6 Q Was there a particular event that
7 caused Monsanto to take the action of advising its
8 customers of potential environmental pollution
9 problems of Aroclor?

10 MR. HARCKHAM: Objection, vague and
11 ambiguous.

12 A I would suggest that it was a series
13 of situations that led to that. It was not any
14 single event, no. It was the accumulation of
15 information from several sources regarding the
16 identity of this material and the samples taken and
17 the unusualness of the sample in that it's, it was
18 hard for Monsanto representatives to understand how
19 PCBs got into pine needles in Sweden, which is not
20 perceived to be a heavy industrial area. Or in the
21 hair from an infant, or even the fish up there near
22 Sweden.

23 So it was the strangeness of these,
24 strange to Monsanto with industrial perspective, to
25 associate PCBs with those presences. Even here in

1 the states we had reports, the pelican off south
2 California wasn't hatching its eggs, and the
3 peregrine falcon out of Cornell University study,
4 this kind of information all kind of was building up
5 to the point where Monsanto decided that we better
6 be responsible and do what we can within reason,
7 without creating explosions in transformers and what
8 not.

9 Q (By Mr. Hausman) Is there any further
10 information that Monsanto gained from what you just
11 described that led it ultimately to withdraw certain
12 PCB products?

13 A Certainly we, we kept learning as we
14 went. Some of the early information proved to be
15 erroneous. I mentioned the peregrine falcon and
16 then the pelicans, those situations were determined,
17 finally, to be due to DDT, although PCBs were found
18 there. The, the availability of alternative
19 materials helped a lot.

20 For example, the availability of a
21 fire resistant dielectric fluid was a real
22 challenge. It just could not be found easily to the
23 point where even the government, if, those of you
24 that have read the Interagency Task Force Report
25 that came out in '72 strongly emphasized that we

1 better not get out of the electrical applications.
2 It's too important. And I think you can visualize
3 what the World Trade Center would be like with a
4 fire up there on different levels where the
5 transformers are located.

6 Nevertheless, the idea was to withdraw
7 from those uses where a reasonable alternative was
8 available with some slight compromise in safety and
9 what have you. And when that was determined to be
10 possible, Monsanto moved. They didn't wait for the
11 government to dictate when to get out.

12 Q And just to place a time period on
13 that decision, was that in the early '70s?

14 A The decision to phase out, the first
15 step I want to call it was really arrived at, that's
16 a poor choice of words, in about April or May of
17 1970, and the recommendation was made to the top
18 executives in Monsanto and the program was approved
19 and the, what we call open uses, that's use in
20 paint, caulking materials, carbonless copy paper,
21 those uses were terminated starting on August of
22 1970.

23 The heat transfer and hydraulic fluid
24 applications were perceived to be closed systems.
25 Nobody designs a leaking system deliberately, so we

1 said, well, wait a minute. We can tell our
2 customers, don't let it get away from you, and they
3 can still enjoy what we perceive to be important
4 characteristics. Fire and explosion-proof
5 properties.

6 The dielectric business, there was no
7 choice at the time. We just could not come up with
8 any alternative, and we felt quite comfortable that
9 since they were closed, steel boxes in essence with
10 no circulation, no pressure to leak out, if they did
11 leak it was more of an ooze that could be caught
12 quickly, and you could still enjoy the
13 explosion-proof transformer sitting outside your
14 Holiday Inn room. Some of you may have seen those
15 boxes out there.

16 Well, I'm talking more than I should,
17 perhaps, but nevertheless, it was an evolving
18 concept so that once we got rid of the open uses
19 with a lot of unhappy customers, very unhappy, then
20 we moved into the hydraulic fluids, because we had
21 an idea that phosphate esters might be the
22 alternative.

23 But before that we got into the heat
24 transfer because of the applications in the food
25 business and there was some concern about the PCBs

1 finding their way into the food products. So that
2 program took off even before the hydraulic fluids
3 program.

4 I don't know if I answered your
5 question, it's just an evolutionary kind of phasing
6 out.

7 Q Yes. Thank you. In this time period
8 of the late '60s and early '70s, did Monsanto make
9 any -- let me start that over.

10 From the time period of 1968 to the
11 early 1970s, was there any information learned by
12 Monsanto indicating additional possible toxicity
13 from what was already known?

14 MR. HARCKHAM: Objection.

15 A Early '70s? No. Tests were under way
16 sponsored by Monsanto, but they were not anywhere
17 near completion. It would take a couple more years
18 before we would get the end results.

19 Q (By Mr. Hausman) Okay, then, after
20 the early 1970s, did Monsanto learn of any
21 additional toxic effects, potential toxic effects,
22 let's say that, of PCBs from what we discussed
23 earlier today?

24 A Well, we, our studies showed that
25 chickens were affected, the hatchability of their

1 eggs, they also showed that the higher chlorinated
2 types of PCBs affected the weight gain of the test
3 animals, and it affected some of their livers, which
4 was not a surprise, it confirmed what was known
5 before.

6 Q And that's what we discussed earlier,
7 the potential liver damage to animals?

8 A Yes, the liver damage was obvious, but
9 this was the first time that the animals were tested
10 in a multiyear test program, the kind that's used
11 for Food and Drug Administration approvals. The
12 first time to our knowledge it was done on
13 industrial chemical as distinguished from a
14 pharmaceutical or a food or cosmetic application.

15 Q Let me ask to have marked as Exhibit
16 18 a two page document with the date of June 17,
17 1970, first line reads, "Head: How To Keep Your
18 Therminol FR System Leak-Free," has Bates numbers of
19 MONS 080871 through 872.

20 (Defendant's Deposition Exhibit
21 Papageorge 18 marked for identification by the court
22 reporter.)

23 A I have read the document.

24 Q (By Mr. Hausman) Do you recognize
25 this document?

1 A I do.

2 Q And under what circumstances do you
3 recall seeing this document before?

4 A Under what circumstances did I see it?

5 Q Yes.

6 A Well, I was involved in the
7 preparation of the earlier drafts, so I got to see
8 it fairly early, and made my comments, I forgot the
9 specifics of what I said then. Anyway, this is a
10 copy of a, one of the drafts.

11 Q And did Monsanto intend to provide
12 this information to its customers?

13 A Yes.

14 Q Okay. Did this, was this reprinted in
15 some more formal form?

16 A Yes, they had the logo and the colored
17 inks and so on.

18 Q When was that information to be
19 provided to customers?

20 A When?

21 Q Yes.

22 A You mean what year?

23 Q Yeah.

24 A About the middle of 1970. Shortly
25 after the date shown on this document.

1 Q At that time in 1970 did Monsanto
2 institute a procedure of advising its customers to
3 prevent leakage from their heat exchange systems?

4 A Yes.

5 MR. HARCKHAM: Objection.

6 Q (By Mr. Hausman) And why was that?

7 A I'm sorry?

8 Q Why was that program instituted?

9 A It's part of our program of informing
10 the customer to do whatever it could to avoid it
11 getting into the environment.

12 Q And that's PCBs, when you say "it"?

13 A Yes.

14 Q Okay. Let me ask to have marked as
15 Exhibit 19 a one page document, appears to be
16 authored by W.B. Papageorge to W.G. Canham,
17 C-a-n-h-a-m, or Canham, dated July 13, 1970. It has
18 the Bates number of MONS 198181.

19 (Defendant's Deposition Exhibit
20 Papageorge 19 marked for identification by the court
21 reporter.)

22 A I have read the document.

23 Q (By Mr. Hausman) Do you recognize
24 this document?

25 A Yes, I do.

1 Q Do you recall preparing it?

2 A Now that I read it I recall it, yes.

3 Q Okay. Do you recall why you prepared
4 it?

5 A Yes, I was trying to really educate
6 myself a little bit more on what we at Monsanto had
7 learned about leak-proof systems and whether they,
8 what we were doing was comparable to what I
9 understood our customers were doing, or if
10 necessary, share what we were doing with our
11 customers.

12 Q Okay. Who is Mr. Canham?

13 A Mr. Canham was a, one of the Monsanto
14 engineers in the Central Engineering Department.

15 Q Okay. Second paragraph reads,
16 "Monsanto's Therminols (FR Series) contain Aroclors.
17 In order to stay in this business, we are insisting
18 that heat transfer systems be designed to assure
19 minimum loss by leakage or vaporization."

20 Subsequent to this letter, did
21 Monsanto communicate to its customers that heat
22 transfer systems needed to be designed to assure
23 minimum loss by leakage or vaporization?

24 A That was our understanding and that's
25 what we believed in.

1 Q And that was communicated to
2 customers?

3 A Yes.

4 Q Okay. Let me ask to have marked as
5 Exhibit 20 a one page document, again, from W.B.
6 Papageorge to B.W. Corlew, C-o-r-l-e-w, dated also
7 July 13, 1970, Bates number MONS 098182.

8 (Defendant's Deposition Exhibit
9 Papageorge 20 marked for identification by the court
10 reporter.)

11 A I have read the document.

12 Q (By Mr. Hausman) And do you recognize
13 this document?

14 A I do.

15 Q Do you recall preparing the document?

16 A Yes.

17 Q And I take it you prepared it on the
18 same date as Exhibit 19; is that correct?

19 A I'm sorry?

20 Q I will withdraw that question, the
21 document speaks for itself.

22 Who is B.W. Corlew?

23 A Mr. Corlew was a engineer at the
24 Sauget, Illinois, plant, Monsanto's. And he was in
25 their Engineering Services Department, responsible

1 for the kinds of things that I describe in this
2 memo. And I looked to him to see that progress was
3 being made.

4 Q Okay. And for the matters discussed
5 in this memo, was that part of your efforts as you
6 described to educate yourself as to the workings of
7 heat exchange systems?

8 A Educating myself as well as
9 encouraging --

10 MS. RUTTER: I'm going to object just
11 for a minute. He started a question, you started
12 talking, and then he finished the question, and I'm
13 not sure you understood the question. He may be
14 answering a different question than the one you
15 asked. So let's, I suggest we go back to the
16 beginning.

17 MR. HAUSMAN: Could you read back the
18 question as completed just so the witness knows and
19 understands?

20 (Last question read back by the court
21 reporter.)

22 A I don't know that I understand the
23 question that well. The kinds of things I talk
24 about here apply to any PCB application, and if so,
25 then it applies to heat exchange systems, heat

1 transfer systems.

2 Q (By Mr. Hausman) Okay. All right.

3 Okay, I think I understand your answer. Thank you.

4 I'll ask to have marked as Exhibit No.

5 21 a two page document dated August 17, 1970, from

6 W.B. Papageorge to G.L. Jessee, J-e-s-s-e-e, Bates

7 number MONS 098174 through 175.

8 (Defendant's Deposition Exhibit

9 Papageorge 21 marked for identification by the court
10 reporter.)

11 A I have read the exhibit.

12 Q (By Mr. Hausman) And do you recognize
13 this document?

14 A Yes, I do.

15 Q And do you recall why you prepared
16 this document?

17 A It's a result of a visit I made to the
18 plant to observe the kinds of things they were doing
19 to reduce or eliminate PCBs entering into their
20 facilities and on out beyond the plant gate into the
21 environment. And this was my expression of the
22 kinds of things I saw that weren't quite as good as
23 I would have liked to have seen them.

24 Q At your, at that time, 1970, did you
25 consider the use of sand to pick up PCB liquid to

1 be, as you say, a practice that you would prefer
2 didn't happen?

3 A Yes.

4 Q And why is that?

5 A I'd prefer stopping the leakage or
6 loss in the first place. Using sand to absorb it is
7 one way to keep it from entering a water system, but
8 it creates a disposal problem of that contaminated
9 sand, and I was trying to reduce the problems as
10 much as I could in every direction, whether it be
11 the atmosphere, the water, or the landfill.

12 Q Who is Mr. Jessee?

13 A He was the Plant Manager at Anniston,
14 Alabama at that time. He succeeded me.

15 Q Okay. This is the Monsanto plant?

16 A Yes.

17 Q Do you recall whether Monsanto, after
18 August 1970, communicated to any of its customers
19 that they should not use sand to pick up leaked
20 PCBs?

21 A That was one of the strong
22 recommendations we made to our marketing people and
23 to our home office people who might be contacting
24 the customers.

25 Q Okay. Let me ask to have marked as

1 Exhibit 22 a multipage document from W.B. Papageorge
2 to a number of people led by P.J.A. Marsh at the
3 top, has a date of January 8, 1971, Bates range of
4 MONS 099633 through 644.

5 (Defendant's Deposition Exhibit
6 Papageorge 22 marked for identification by the court
7 reporter.)

8 A I have scanned the exhibit.

9 Q (By Mr. Hausman) Just a very few
10 questions. Do you recognize this document?

11 A Yes, I do.

12 Q Okay. And on the last page, referring
13 to the, there's a photocopy of a signature, does
14 that appear to be a photocopy of your signature?

15 A The last page?

16 Q Yes.

17 A Yes.

18 Q Okay. And do you recall why you
19 prepared this document?

20 A I decided that the activities
21 undergoing at that, each month at that time were
22 being performed by so many people within Monsanto,
23 and the group was difficult to accumulate in a
24 conference room and share this data, so I decided to
25 use the monthly status report approach. And each of

1 the individuals listed are contributors to different
2 sections in it, so I act as sort of the scissors and
3 paste person, putting it together so that each of
4 them knows what the others are doing.

5 Q Okay. I'll refer you to the first
6 page under the heading Marketing, the very first
7 sentence reads, "Efforts continue to educate
8 Therminol FR users to control leakage."

9 A Yes.

10 Q Does that reflect that the marketing
11 people undertake those efforts?

12 A Yes.

13 Q All right.

14 A That's their contribution to this
15 effort.

16 Q Understood. Thank you. I want to go
17 off the record.

18 (A brief recess was held at this
19 time.)

20 Q (By Mr. Hausman) Okay, Mr.
21 Papageorge, let me show you, first ask to be marked
22 as Exhibit No. 23 a two page document from T.L.,
23 actually it's illegible, it's a name that starts
24 with G, dated September 1, 1971, subject is
25 Therminol FR Fluids, T.L. Gossage, maybe, and the

1 Bates number is MONS 098533 through 534.

2 (Defendant's Deposition Exhibit
3 Papageorge 23 marked for identification by the court
4 reporter.)

5 Q (By Mr. Hausman) Mr. Papageorge, this
6 unfortunately isn't the most legible document, so
7 let me read the first several sentences into the
8 record just so we're clear.

9 "Because of increasing PCB
10 environmental pressures and questions as to whether
11 we can effectively 'close the loop' and eliminate
12 leaks in heat transfer systems, we have decided in
13 the United States to initiate a policy of no new
14 systems on Therminol FR fluids. We intend that
15 there will be no exceptions to this policy."

16 Also I note that there appears to be a
17 handwritten CC with the first name indicated as
18 Papageorge. Do you recognize this document?

19 A As I read it I recall it, yes.

20 Q Did Monsanto make a decision in 1971
21 to initiate a policy of no new systems of Therminol
22 FR fluids?

23 A Yes.

24 Q Okay. Why did it do that?

25 A It was primarily based on some

1 incidences that involved PCBs used as heat transfer
2 fluids getting into food and animal feed products.
3 In order to avoid future incidences of that type,
4 alternative fluids were developed but sacrificing
5 the fire resistance.

6 Those changeovers appeared to be
7 successful, and with that success and with the
8 continual leakage of the industrial type heat
9 transfer systems, it was decided that Monsanto would
10 not sell the PCB type fluids to the new systems, and
11 eventually it decided to promote the drainage of the
12 old systems and replacing with these alternative
13 materials.

14 Q Okay. Was the decision to promote
15 changeouts of those systems, was that in 1972, to
16 your recollection?

17 A The decision, did you ask me was it
18 made in '72 or --

19 Q Yes. Or earlier.

20 A It was made about the time of this
21 memorandum, September '71, and evolved, by '72 we
22 were pretty far along, as I remember.

23 Q Okay. That's all with that document.
24 Let me ask to have marked as Exhibit 24 a multipage
25 document indicated as Copy on the front page, says

1 December 8, 1971, Job indicated as Therminol
2 Conversion Bulletin, has a Bates range of MONS
3 079843 through 866.

4 (Defendant's Deposition Exhibit
5 Papageorge 24 marked for identification by the court
6 reporter.)

7 Q (By Mr. Hausman) Mr. Papageorge, I'm
8 not going to have any specific questions on this
9 document, I just want to ask you if you recognize
10 this document.

11 A I recognize this as a draft, not a
12 final version, of an attempt to put in brochure form
13 a conversion program.

14 Q And that was a brochure form for, at
15 least to your customers?

16 A Yes.

17 Q Do you recognize the handwriting
18 throughout the document? I guess the real question
19 is is that your handwriting?

20 A It's not my handwriting. I don't know
21 whose it is.

22 Q Okay. Do you know whether the
23 information in this document was ultimately
24 converted into a final brochure?

25 A Yes.

1 Q And was that in 1971, 1972?

2 A Early '72 was the final version.

3 Q Okay. Thank you. Okay.

4 Let me ask to have marked as Exhibit
5 25 a multipage document entitled Monsanto's PCB
6 Program, apparently prepared by W.B. Papageorge for
7 a meeting date September 14, 1971, and has Bates
8 range of MONS 041633 through 648.

9 (Defendant's Deposition Exhibit
10 Papageorge 25 marked for identification by the court
11 reporter.)

12 A I have scanned the document.

13 Q (By Mr. Hausman) Do you recognize
14 this document?

15 A Yes, I do.

16 Q And do you recall why you prepared
17 this document?

18 A Yes.

19 Q Why is that?

20 A I was appointed to be Chairman of a
21 American National Standards Institute committee to
22 address the issue of control of entry of dielectric
23 PCB containing fluids into the environment.

24 At the first meeting of the, I'm going
25 to call it a working meeting where the committee was

1 to get serious about which, what it was going to
2 produce, I prepared this presentation to bring
3 everyone in the room up to date. Several of the
4 people there had already heard this or these kinds
5 of thoughts; there were others that were totally new
6 to the issue, so my intent was to bring them up to
7 date.

8 Q Was the information in this
9 preparation put into any type of publication by this
10 group?

11 A No.

12 Q Do you recall whether any customers of
13 Monsanto attended this meeting?

14 A Oh, yes.

15 Q Do you know whether Reynolds sent
16 anybody to this meeting?

17 A I don't recall Reynolds being present,
18 no.

19 Q Let me ask to have marked as Exhibit
20 26 a multipage document entitled Discontinuation of
21 Therminol FR Sales, no apparent date indicated, has
22 Bates number of MONS 043488 through 496.

23 (Defendant's Deposition Exhibit
24 Papageorge 26 marked for identification by the court
25 reporter.)

1 A I have scanned the exhibit.

2 Q (By Mr. Hausman) Thank you. Do you
3 recognize this document, Mr. Papageorge?

4 A I have seen it before, yes, sir.

5 Q And under what circumstances have you
6 seen it before?

7 A As best I recall, Mr. Gossage's
8 secretary brought a draft by the office for me to
9 review. That was my first exposure to this.

10 Q And who is Mr. Gossage?

11 A Mr. Gossage at the time was the Sales
12 Director of the group that marketed Therminols.

13 Q Did you provide comments for this,
14 this draft?

15 A I did, but I frankly don't remember
16 the details. I don't remember the very first draft
17 I saw.

18 Q Was a document prepared for
19 distribution to customers pursuant to this?

20 A This document was really prepared for
21 the upper management, as you'll note, and on, also
22 the field salesmen.

23 Q All right.

24 A To help them respond to any questions
25 that they might be asked by the customers.

1 Q So when you say "upper management,"
2 you mean upper management of Monsanto?

3 A Yes.

4 Q All right. When you were the Manager
5 of Environmental Control or Environmental
6 Protection, did you receive any reports on the
7 status in progress of any changeouts at Reynolds'
8 Massena facility?

9 A Yes.

10 Q From whom did you receive those
11 reports?

12 A Coordinator of the Therminol program,
13 Paul Gann, G-a-n-n, would either tell me personally,
14 verbally, orally, or he would also prepare, as I
15 recall, a status report in which he listed customers
16 and the last contacts made and the progress they
17 were making. Mr. Gann was my principal source of
18 information.

19 Q Okay. Do you know whether he visited
20 the Massena Reynolds plant at any time?

21 A I don't know that.

22 Q Did you ever have any interaction with
23 a Monsanto employee named Dean Danzer?

24 A Yes.

25 Q What kind of contacts did you have

1 with Mr. Danzer?

2 A At what point in time?

3 Q Fair enough. At the point in time
4 when Reynolds was changing out its heat transfer
5 system.

6 A Mr. Danzer was assigned to assist Mr.
7 Gann's efforts in these Therminol changeovers. He
8 had located temporarily in the building that the
9 rest of us were located, so I would meet him in the
10 hallways or he'd drop by the office, because we had
11 known each other previously, so he felt he could
12 drop in any time and tell me how things were going
13 and what, what had transpired. And that's how I
14 kept in touch, really, with the kinds of activities
15 that he was personally involved with.

16 Q Let me ask to be marked as Exhibit No.
17 27 a two page document with the heading Sales
18 Meeting, Tuesday, April 27, 1971, has a Bates number
19 of REY 000359 through 360.

20 (Defendant's Deposition Exhibit
21 Papageorge 27 marked for identification by the court
22 reporter.)

23 Q (By Mr. Hausman) Mr. Papageorge, the
24 reason I show you this document is I see the
25 initials W.P. about two-thirds of the way down the

1 first page after Environment and Pollution.

2 A I see that W.P.

3 Q Do you recall attending a sales
4 meeting on April 27, 1971?

5 A I've attended so many sales meetings,
6 this seems very typical.

7 Q Okay.

8 A Nothing stands out as being unique.

9 Q On the second page Reynolds Metals is
10 indicated, the name Reynolds Metals is indicated.
11 Do you recall --

12 MR. HARCKHAM: Can I just, for the
13 record, I take it this page is redacted, Carol?

14 MS. RUTTER: Yes.

15 MR. HARCKHAM: So there was actually
16 seven that were on the original list, the original?

17 MS. RUTTER: It's been a few months,
18 but it certainly appears so.

19 MR. HAUSMAN: And I think, from the
20 production, I take it that you redacted names of
21 other customers?

22 MS. RUTTER: Yes.

23 (An off the record discussion was held
24 at this time.)

25 Q (By Mr. Hausman) Okay, back on the

1 record. Mr. Papageorge, do you recall discussions
2 of Reynolds Metals at sales meetings in 1971?

3 A Yes.

4 Q Do you recall what was discussed?

5 A I'm sorry?

6 Q Do you recall what was discussed?

7 A I recall in general that PCBs were
8 present at the sites, that communications were good,
9 that once the message was understood, that the
10 response was very sophisticated. They're right up,
11 up to it.

12 Q Do you recall seeing any report --
13 MR. HARCKHAM: Had you finished your
14 answer?

15 MR. HAUSMAN: I'm sorry. Please.

16 A The net result is that I felt, from
17 what I heard and gathered, that things were going
18 well and it didn't need my personal visit or
19 involvement or telephone calls. In other words, I
20 felt comfortable with what I heard, and I used my
21 time on the other problem customers that we were
22 facing.

23 Q (By Mr. Hausman) Do you recall what
24 measures Reynolds took in the early '70s in response
25 to the communications that were sent to it from

1 Monsanto?

2 MS. RUTTER: I would object to the
3 overbroad and vague form of the question.

4 A I don't remember details. I do
5 remember the general impression that I was left with
6 that they were aware of the environmental issue,
7 that leakage was and could be a problem unless
8 attention was paid to maintenance and the like and a
9 conversion did take place, there was some return of
10 old material to be destroyed, I remember that.
11 There was nothing in a, in a negative way that
12 stands out as being a real problem. So everything
13 appeared to be to me kind of impression.

14 Q (By Mr. Hausman) All right. Do you
15 recall receiving any reports of leaking heat
16 transfer medium system at the Reynolds Massena
17 plant?

18 MS. RUTTER: Objection to the
19 overbroad and vague form of the question.

20 A I just, no, nothing stands out in that
21 area.

22 Q (By Mr. Hausman) Do you recall
23 receiving any reports of a, an explosion of the HTM
24 system that took place in the 1950s at the Reynolds
25 Massena plant?

1 A Explosion in the '50s. Reynolds
2 plant, no, I don't recall that.

3 Q Okay, let me ask to have marked as
4 Exhibit 28 a one page letter dated August 16, 1972
5 from W.B. Papageorge to Mr. B.P. Collins, Bates
6 number REY 000403.

7 (Defendant's Deposition Exhibit
8 Papageorge 28 marked for identification by the court
9 reporter.)

10 A I have read the exhibit.

11 Q (By Mr. Hausman) Do you recall
12 preparing this letter?

13 A Hmm?

14 Q Do you recall preparing this letter?

15 A Yes.

16 Q It states that, "In response to your
17 telephone request I am forwarding under separate
18 cover samples of Aroclor 1242 and Aroclor 1254." Do
19 you recall why you sent these Aroclor samples to
20 Reynolds?

21 A He asked for them.

22 Q Did he say why?

23 A Oh, you mean what he wanted them for?

24 Q Yes.

25 A I understood that his, he was going to

1 go to some laboratory somewhere and set up a program
2 for analyzing PCBs and he needed the, these samples,
3 virgin material as a standard to compare the unknown
4 against, and the 1242 and 1254 gave him the right
5 range of types that his analyst might want to look
6 at.

7 Q Did you talk to -- I'm sorry. You
8 didn't finish.

9 A I do not know the specifics regarding
10 exactly what he was looking and where.

11 Q Did you talk to Mr. Collins or did he
12 send a letter?

13 A Oh, he, he called me on the phone.
14 Well, actually he called Monsanto and it eventually
15 got transferred to my phone.

16 Q I see. Are you familiar with the name
17 Larry Tropea from Reynolds?

18 A Larry, how do you spell his last name?

19 Q Tropea, T-r-o-p-e-a?

20 A I've seen it in print. I don't know
21 the man personally.

22 Q You don't recall talking to him?

23 A No.

24 Q Let me ask to have marked as Exhibit
25 29 a four page document from W.B. Papageorge with no

1 addressee indicated on the front, dated April, 1972,
2 Bates number REY 000062 through 065.

3 (Defendant's Deposition Exhibit
4 Papageorge 29 marked for identification by the court
5 reporter.)

6 A I have scanned the exhibit.

7 Q (By Mr. Hausman) Do you recognize
8 this document?

9 A I do.

10 Q Is this a form letter?

11 A In a way, yes. We just type in the
12 addressee.

13 Q Okay. And I refer to the third and
14 fourth pages?

15 A I'm sorry?

16 Q The third and fourth pages of this
17 exhibit, there are various addresses, do you know
18 whether that indicates that Reynolds was sent copies
19 of these?

20 A Yes, it does. This is a copy of the
21 labels that were typed, and before they were affixed
22 either to the letter or to the envelope, they were
23 photographed to give us a record.

24 Q And why did you prepare this letter?

25 A Well, as it says in the letter, I got

1 a call, one of many calls from EPA representatives
2 wanting to know names of our customers, the types of
3 PCBs they bought, how much they purchased, when, all
4 those details, and Monsanto resisted that, but the,
5 I sensed that the pressure was building and I wanted
6 the customers to know that we were trying to avoid
7 disclosing a customer list, for many reasons that
8 are understood by industry. Anyway, I just wanted
9 them to know that the day may come when we would be
10 forced to divulge such a list, and that was the
11 purpose of this, as well as I took advantage of the
12 opportunity to again say don't get it in food feed
13 and so on. Next to last paragraph.

14 Q Okay. That was my next question.
15 Thank you.

16 Was there a point in time after 1972
17 where Monsanto -- let me start over.

18 Was there a point in time after 1972
19 where you became aware that a single changeout of a
20 heat exchange system would not eliminate all PCBs in
21 that system?

22 MS. RUTTER: Objection to the vague
23 form of the question.

24 MR. HARCKHAM: Join.

25 MS. RUTTER: If you understand it, you

1 may answer.

2 A I'm having difficulty understanding,
3 the degree of success in changeout to totally
4 eliminate the presence of PCBs will vary with the
5 care and attention given to the changeout. Just
6 opening a spigot and draining doesn't do it. You
7 got to change gaskets, you got to clean out and
8 flush the system, if there's any residue in it it's
9 going to retain the PCBs, which will be loosened or
10 freed by the new fluid. Is that the, is that the
11 answer? I don't know that I understand your
12 question.

13 Q (By Mr. Hausman) Let me show you a
14 document. Let me have marked as Exhibit No. 30 a
15 three page document from D. Wood, no addressee
16 indicated on the front, August 7, 1978, Bates number
17 REY 000073 through 75.

18 (Defendant's Deposition Exhibit
19 Papageorge 30 marked for identification by the court
20 reporter.)

21 A I have read the exhibit.

22 Q (By Mr. Hausman) Do you recognize
23 this document?

24 A I have not seen it before.

25 Q Are you aware of whether Monsanto

1 instituted a program of advising its customers that
2 they may have to further change out systems to
3 eliminate or reduce residual PCBs?

4 MS. RUTTER: Object to the form of the
5 question.

6 A I'm aware of communications to
7 customers undergoing these changes in the Therminol
8 systems that covered the need for a thorough
9 flushing, circulating, running the system for weeks
10 before you drain the flush, sometimes it took a
11 second flush. I'm aware that they talked about the
12 degree of contamination in the vent tank they called
13 it, the storage tank, the degree of material that
14 deposited on the walls of the tank as well as within
15 the pipelines and how they could be loosened by the
16 new fluid. I'm aware of the pump packing, that's
17 the soft material that keeps the liquid from gushing
18 out off the, away from the pump, how that has to be
19 changed and the proper type selected for the future.
20 All these things are just very necessary, and they
21 were communicated, to the best of my knowledge.

22 Q (By Mr. Hausman) And let me ask to
23 have marked as Exhibit 31, stepping back a little
24 bit in time, a letter dated August 31, 1970, from
25 W.B. Papageorge to Mr. Bruce S. Hulcher, Bates

1 number REY 000395 through 396.

2 (Defendant's Deposition Exhibit
3 Papageorge 31 marked for identification by the court
4 reporter.)

5 A I have read the document.

6 Q (By Mr. Hausman) Do you recognize
7 this document?

8 A Yes, I do.

9 Q Do you know why you prepared it?

10 A I'm sorry?

11 Q Do you know why you prepared it,
12 excuse me.

13 A I think it's Dr. Hulcher?

14 Q Yes.

15 A He wrote to the Marketing Director,
16 Don Olson at that time, in which he asked questions.
17 Mr. Olson asked me to respond, and this is my
18 attempt to respond to those areas of interest.

19 Q Okay. And what is Pydraul used for?

20 A Pydraul is the PCB containing
21 hydraulic fluid.

22 Q Okay. Let me ask to have marked as
23 Exhibit 32 a series of consecutive documents with a
24 Bates range from REY 000001 through 036. I
25 represent that I put these together one, because

1 they're consecutive, and two, they're similar
2 documents for easy reference. I'm introducing them
3 in one exhibit so we don't have 36 different ones.

4 (Defendant's Deposition Exhibit
5 Papageorge 32 marked for identification by the court
6 reporter.)

7 A I have scanned through the exhibit.

8 Q (By Mr. Hausman) Thank you. While
9 you were employed by Monsanto, did you have occasion
10 to see sales summaries such as these?

11 A Oh, yes.

12 Q Is this something that Monsanto
13 prepared in the normal course of business?

14 A Yes.

15 Q In what department were those
16 prepared?

17 A It was a service provided by accounts
18 receivable, I believe, department for the marketing
19 group.

20 Q And is that in St. Louis or elsewhere?

21 A St. Louis headquarters.

22 Q Let's look at the first page. Let me
23 again give the proviso, if you don't know the answer
24 to this, please let me know. I don't want you to
25 guess or anything, but only if you if you have

1 specific knowledge.

2 Note that the date is, in the upper
3 right hand corner is indicated as December '59?

4 A Yes.

5 Q Do you know whether the numbers
6 indicated as Sales This Year to Date, whether those
7 indicate total sales of that product to that company
8 for the full year?

9 A For the year '59.

10 Q So it wouldn't be an individual
11 shipment, it would be a total of all the shipments;
12 is that correct?

13 A Correct.

14 Q All right. Okay. I'd like to go
15 through the various products that are indicated
16 here. The first page reflects Pydraul F-9, is that
17 a hydraulic fluid?

18 A Yes.

19 Q And does that contain PCBs?

20 A Does it what? I'm sorry.

21 Q In 1959, did that material contain
22 PCBs?

23 A Yes.

24 Q Okay. Do you know what type of PCB it
25 contains in terms of, again, the four digit number?

1 A One of the 40s, but I, I'm not
2 certain.

3 Q Okay. What is the appearance of
4 Pydraul F-9 at room temperature?

5 A I would say, as I remember, it's a
6 purple colored liquid that looks like about the
7 consistency of, let me say, mineral oil, baby oil.

8 Q Was it soluble in water?

9 A No. Well, I, everything is soluble to
10 a degree, but it's not like salt is soluble in
11 water.

12 Q Okay.

13 A It will, some components will
14 dissolve, some components might sink if agitated and
15 all, and the PCBs would sink if they're separated,
16 and some would float. So depending on the, the
17 conditions that it finds itself in, it could react
18 with water in any of those ways.

19 Q All right. If any Pydraul F-9 were
20 exposed to the air, would any PCBs volatilize?

21 A No. Very few. You could probably
22 measure with the sophisticated instruments today,
23 but for all practical purposes, no.

24 Q And did the PCBs in Pydraul F-9 have a
25 tendency to bond to soils?

1 A Yes.

2 MR. HARCKHAM: Objection, lack of
3 foundation.

4 Q (By Mr. Hausman) Okay, let's turn to
5 the second page, Bates number I think 2? Is Pydraul
6 A-200 also a hydraulic fluid?

7 A Yes.

8 Q And how did that differ from Pydraul
9 F-9?

10 A It depends on the type of PCB used as
11 well as other ingredients. They're a little,
12 slightly different.

13 Q Do you recall what type of PCB was
14 used on that Pydraul?

15 A No, I'd have to see the recipes again
16 to refresh my memory.

17 Q Was that also a purple, oily liquid?

18 A Yes.

19 Q Same solubility characteristics that
20 you described for F-9?

21 A Well, the solubility varies with the
22 type of ingredients, so since they're not identical,
23 there, there will be a difference.

24 Q Do you know whether it was more
25 soluble or less than F-9?

1 A No, I wouldn't. I'd have to see the
2 ingredients again.

3 Q Okay. Referring to the third page,
4 Aroclor DIST 1248, I take that to mean that's a 1248
5 PCB; is that correct?

6 A That's right.

7 Q Is that a heat exchange fluid?

8 A Yes.

9 Q What were the characteristics, what
10 was the appearance of Aroclor 1248?

11 A Well, it's a little bit heavier than
12 baby oil that I used the reference earlier. In its
13 pure condition it's clear as water. It may have a
14 tinge of yellow occasionally. In use it could
15 darken after years of use, it could have a deeper
16 tinge of yellow.

17 Q And what are the solubility
18 characteristics of Aroclor 1248?

19 MR. HARCKHAM: Objection, lack of
20 foundation.

21 A As I remember, the solubility of 1248
22 is less than 200 parts per billion in water at room
23 temperature. Less than that.

24 Q (By Mr. Hausman) If water and Aroclor
25 1248 were in contact, would those two substances

1 separate?

2 A Yes.

3 MR. HARCKHAM: Objection.

4 Q (By Mr. Hausman) And which is denser,
5 water or 1248?

6 A Sorry?

7 Q Which is denser, water or Aroclor
8 1248?

9 A 1248 would sink to the bottom.

10 Q So there would be water on top?

11 A Water on top.

12 Q Okay. Turning to the document in this
13 set with the Bates number ending 10? Therminol FR-2
14 I believe we spoke about, could you remind me, what
15 was the Aroclor number for FR-2?

16 A 1248.

17 Q Is the appearance of Therminol FR-2
18 the same as Aroclor 1248?

19 A Yes.

20 Q And the characteristics that we
21 described are the same?

22 A Identical.

23 Q Turn to the page with the Bates number
24 ending 18, it's somewhat difficult to read but it
25 seems to indicate Pydraul 135? I'll let you get to

1 that page.

2 A That's what I, that's what I read.

3 Q Is Pydraul 135 a product that Monsanto
4 sold?

5 A Yes.

6 Q And for what use?

7 A Hydraulic fluid.

8 Q And what was the corresponding Aroclor
9 number with Pydraul 135?

10 A I don't remember all those Pydraul
11 recipes.

12 Q Okay. So you don't know off the top
13 of your head?

14 A I don't recall it, no.

15 Q Let's have marked as Exhibit 33 a
16 multipage document with the legend New York PCB
17 content, 1968 to 1969, Bates range REY 000262
18 through 278.

19 (Defendant's Deposition Exhibit
20 Papageorge 33 marked for identification by the court
21 reporter.)

22 Q (By Mr. Hausman) That's I believe to
23 be another document with customer names redacted
24 except for Reynolds.

25 A I have scanned the exhibit.

1 Q Okay. Mr. Papageorge, understanding
2 that the names of customers have been redacted out
3 of this document, have you seen documents in this
4 form before when you were at Monsanto?

5 A This is the first I've seen.

6 Q Okay. So you don't, you can't tell me
7 what the numbers refer to?

8 A I don't even understand it.

9 Q All right. Fair enough. Let me ask
10 to have marked as Papageorge Exhibit No. 34 a
11 multipage document, the first page reads, "Exhibit L
12 (Revised)," second page reads "PCB Waste Returns,"
13 Bates number REY 000279 through 285.

14 (Defendant's Deposition Exhibit
15 Papageorge 34 marked for identification by the court
16 reporter.)

17 A I have scanned the exhibit.

18 Q (By Mr. Hausman) Okay. Again with
19 the proviso that customer names appear to have been
20 redacted, do you recognize this form of document?

21 A I have seen similar documents. I
22 don't remember whether I saw this specific version.

23 Q I understand. Under what
24 circumstances have you seen similar documents?

25 A That was part of my attempt to keep up

1 to date on what was going on regarding return
2 material for incineration.

3 Q All right. Let me show you another
4 similar document I'm going to ask to have marked as
5 Exhibit 35, a document titled Item 5, Attachment B,
6 PCB Returns, Bates number REY 000286 through 291.

7 (Defendant's Deposition Exhibit
8 Papageorge 35 marked for identification by the court
9 reporter.)

10 A I have scanned the exhibit.

11 Q (By Mr. Hausman) Okay. And again, do
12 you recognize this form of document?

13 A Yes.

14 Q Is this something that Monsanto kept
15 in the normal course of business?

16 A Yes.

17 Q For both of these documents, Exhibits
18 55 and, or 35 and 36, who was responsible for
19 preparing these documents?

20 A I don't know.

21 Q The heading of 35 is PCB Waste Returns
22 and 36 is PCB Returns, you see that?

23 A I see that, yes.

24 Q To your knowledge is there a
25 distinction between those two items, a PCB return

1 and a PCB waste return?

2 A I interpret both of those as being
3 material return for incineration. There's nothing
4 to tell me that these are PCBs unused, still in the
5 original container being returned for other reasons
6 other than incineration.

7 Q Based on your knowledge of how these
8 charts were set up, if a company were to return
9 unused PCB fluid pursuant to the program in 1971,
10 would that amount be reflected on either one of
11 these charts?

12 A It would be reflected in this summary,
13 yes. As return material for dispose, for
14 incineration.

15 Q Okay. If a company also returned used
16 material that was taken out of its system, such as a
17 heat transfer system, would that amount be reflected
18 in these reports?

19 A Yes. Yes.

20 Q So there would be no distinction
21 between the two?

22 A That is true. At that year, 1971 and
23 on.

24 Q Okay if you refer to, yeah, Exhibit 34

25 --

1 (An off the record discussion was held
2 at this time.)

3 Q (By Mr. Hausman) Okay. Exhibit 34,
4 which is the first one that starts Exhibit L, if you
5 look on the page 283?

6 A 282?

7 Q 283. You see the quantity indicated
8 for Reynolds Metal, Massena, New York, indicated at
9 7,655?

10 A For Massena, yes.

11 Q Okay. And if you refer to Exhibit 35,
12 page 289, that same number, 7,655 is indicated. Do
13 you see that?

14 A Yes.

15 Q Do you understand those numbers to be
16 referring to the same returned PCB material?

17 A Yes, sir.

18 Q Okay. The customer-returned material
19 that was used for flushing out a system as opposed
20 to the PCB material itself?

21 A Yes.

22 Q Would that quantity be reflected in
23 either one of these charts?

24 A Yes. It would be part, it would be
25 considered a waste PCB, or incineration material.

1 Q So that as well would be included in
2 this 7,655 number?

3 A That's right.

4 Q Are you familiar with a process of
5 biodegradation of PCBs?

6 A I'm sorry, the bio what?

7 Q Biodegradation?

8 A Yes, sir. To a degree. I'm not a
9 biologist.

10 Q Okay. Is that something you ever
11 studied when you were at Monsanto, how PCBs
12 biodegrade?

13 A Yes, I was involved in monitoring,
14 staying close to Monsanto studies, both in Wales,
15 England, United Kingdom and in the United States,
16 St. Louis.

17 Q And based on your monitoring, what is
18 biodegradation of PCBs?

19 A Biodegradation refers to the situation
20 where bacteria that are acclimated to a PCB type
21 environment start to consume the PCBs as a food
22 source, and in so doing, they break up the PCB
23 configuration to the point where an analyst looking
24 for PCBs doesn't see PCBs any more. It's some other
25 material now.

1 Now, the rate at which this change in
2 PCBs takes place depends on how many chlorines are
3 associated with each PCB. The more chlorines
4 involved, the more difficult it is for the bacteria
5 to get into the, to get to the carbon.

6 So we find that the lower chlorinated
7 PCBs are more apt to disappear in such a situation
8 than the higher chlorinated.

9 Q Okay.

10 A So the residual that the analyst sees
11 is a distortion of the virgin material. All the
12 analyst sees is the higher chlorinated types, and by
13 the protocol set up by the analytical community, he
14 has to identify that as one of the Aroclors. And so
15 he takes a standard and says, well, it more matches,
16 it looks more like 1260. It may well have started
17 out as 1242. And that match that he's describing is
18 not a perfect match. It's the closest he can get to
19 it. The analyst on the next bench may decide to
20 call it 1254 because that's the way it looks to him.

21 Q Based on your knowledge in reading
22 information and also your knowledge as a chemist,
23 does this change in detection go in the other
24 direction? You just described the possibility of a
25 lower Aroclor being identified as a higher number.

1 Does it go in the other direction? For example,
2 could a 1260 be misidentified, that start -- let me
3 start again.

4 Could an Aroclor that started as 1260
5 over time be misidentified as a 1242?

6 MR. HARCKHAM: Objection, lack of
7 foundation.

8 MS. RUTTER: I object to the vague
9 form of the question.

10 MR. HARCKHAM: I join in that
11 objection.

12 THE WITNESS: I'm not aware of any
13 studies that demonstrated that that could happen.
14 Nothing has been found where bacteria will take a
15 PCB and remove chlorine from it to get it to look
16 more like the lower chlorinated. I know, I've heard
17 nothing along those lines. The opposite has been
18 demonstrated.

19 MR. HAUSMAN: Let's go off the record
20 for about two minutes.

21 (A brief recess was held at this
22 time.)

23 MR. HAUSMAN: Mr. Papageorge, I don't
24 have any more questions. I thank you very much for
25 your patience.

1 THE WITNESS: Thank you.

2 EXAMINATION BY

3 MS. REIMER:

4 Q Good afternoon, Mr. Papageorge.

5 A Good afternoon.

6 Q As you know, my name's Nancy Reimer
7 and I'm from Mintz Levin and I represent Liberty
8 Mutual in this case. I just have a couple follow up
9 questions for you.

10 My first question is during the course
11 of your tenure at Monsanto, did you ever visit the
12 Reynolds corporate headquarters in Richmond,
13 Virginia?

14 A No.

15 Q Did you ever have any communications
16 with anyone from Reynolds corporate headquarters in
17 Richmond, Virginia, while you were at Monsanto?

18 A Yes, Dr. Hulcher and Mr. Collins, this
19 was over the telephone, and Dr. Hulcher was both
20 telephone and letter communications.

21 Q You testified this afternoon about
22 certain communications you had with Dr. Hulcher,
23 correct?

24 A Yes.

25 Q I don't want to revisit that, so my

1 question is in addition to that topic which you had
2 conversations with with Dr. Hulcher, did you have
3 any other discussions with Dr. Hulcher?

4 A Oh, I had several. Today I don't
5 remember the specific topics discussed, but it was
6 certainly more than just one contact.

7 Q Do you recall in general what you
8 discussed with Dr. Hulcher and can you put it into
9 the context of a time frame?

10 A In general? In general of course it
11 had to do with heat transfer alternatives and what
12 our experience had been. The topic was so, so
13 common amongst many calls that I got that nothing
14 stands out as being distinct to Reynolds.

15 Q Were the discussions with Dr. Hulcher
16 during the 1970s?

17 A No.

18 Q Did they predate the 19 --

19 A They were, no. It seems to me they
20 were in '72? As best I recall, it wasn't in early
21 '70s, it was either late '71 or early '72.

22 Q Do you recall if in that time frame in
23 1972 you had any discussions with Dr. Hulcher
24 concerning the changeover to the HTM system at the
25 Massena plant at Reynolds?

1 A Would you repeat that little part? My
2 hearing is going on me.

3 Q Let me have the reporter read it back.
4 (Last question read back by the court
5 reporter.)

6 A HTM?

7 Q (By Ms. Reimer) I mean the heat
8 transfer medium fluid system.

9 A Oh, I thought it was a special fluid.
10 Yes, that was part of our general discussion. As I
11 remember, Dr. Hulcher was really trying to assure
12 himself that the information he was getting from
13 others in Monsanto kind of all fit together.
14 Confirming that he, what he had heard from others.
15 That's the impression I got, and I also got the
16 impression he felt that since I was the guy that was
17 flying into Washington and all, whether I heard
18 anything new that was coming down the pike at him,
19 and he wanted to be tuned in on that.

20 Q Did you have any discussions with Dr.
21 Hulcher concerning the specific system up in the
22 Massena plant that used the H -- the heat transfer
23 medium fluid, the specific process that was used up
24 in Massena?

25 A I remember the reference to the pitch

1 and the carbon. But I did not get details as to
2 exactly how the system was designed and so on.

3 Q What do you remember about the
4 conversation you had with him about the pitch?

5 A Other than he described what they used
6 the heat transfer medium for, to soften or fluidize
7 the pitch and, so that they could process it and go
8 about their business of making anodes.

9 Q Did you have any discussions with him
10 concerning whether there were any leaks in the
11 system that was used at Massena?

12 A Leaks. I don't remember specific
13 mention of leaks.

14 Q Do you remember any general
15 discussion?

16 A In general we talked about the need to
17 prevent leakage, maintain the equipment, as soon as
18 a leak occurred, to address it immediately, take
19 care of it, either put a pan under it or put a
20 wrench through the pipe or whatever it takes to stop
21 it. We talked about those kinds of things in
22 general.

23 Q Did Dr. Hulcher ever convey to you
24 that the Massena plant had a problem with leaks or
25 the, with the wear in the system or anything of that

1 nature?

2 A No, I did not get that impression, no.

3 Q And this was in 1971, '72, right?

4 A Late '71, '72, as best I can place it.

5 Q Did you discuss any other part of the
6 Massena plant with Dr. Hulcher?

7 A No.

8 Q Did you have any discussions with him
9 about whether the pitch ever interacted with the
10 material containing PCBs at any point in time in the
11 process?

12 A I don't remember that at all, no.

13 Q Now, I believe you stated you also had
14 conversations with Mr. Collins? Did I get that
15 right?

16 A I remember Mr. Collins' telephone call
17 where he asked for the samples.

18 Q Which, that's what you talked about
19 this afternoon with Mr. Hausman, right?

20 A Yes.

21 Q Right. Did you have any other
22 conversations with Mr. Collins?

23 A I don't recall any other.

24 Q Okay. Who was Mr. Collins?

25 A He was with Reynolds, of course, and

1 I, I jumped into a conclusion, assuming that he was'
2 a chemist, asking for samples to work in his
3 laboratory. I didn't feel I had to ask him, "Are
4 you the President," or anything like that.

5 Q Do you recall what the time frame was?

6 A The time frame?

7 Q Yeah, that he asked you for the
8 samples?

9 A I don't remember right now, no. The
10 letter that I wrote to him responding to his request
11 ought to place the timing.

12 Q Contemporaneous with the letter, it
13 would be --

14 A Oh, yes, within 24 hours.

15 Q Okay. When you were testifying this
16 afternoon, and I believe you were talking about
17 Exhibit 27, which was a sales meeting on April 27 of
18 1971, and you were asked how Reynolds, and I don't
19 want to put words into anyone's mouth, so I'll just
20 paraphrase the background question, how Reynolds
21 reacted when they were told that there were the
22 problems with the use of PCBs and they were being
23 phased out, and you responded by saying once the
24 problem was understood, it was resolved in a prompt
25 manner. Do you recall that?

1 A Yes.

2 Q What do you mean by "once the problem
3 was understood," and understood by whom?

4 A Well, by the people within the
5 Reynolds organization who were approached and
6 informed by Monsanto, either by mail or personal
7 contacts.

8 Q Did you know who those people are
9 specifically? In other words, was it Dr. Hulcher or
10 was it Larry Tropea or was it somebody else, if you
11 know?

12 A Oh, gee, I don't know the names of the
13 people, no.

14 Q And when you said "once the problem
15 was understood," do you know how long it took
16 Reynolds to understand the problem? Was this
17 something that went on for a few months or --

18 A Oh, I have no feel for the timing.

19 Q Okay. Do you know if Reynolds
20 challenged Monsanto's directives in any way? Did
21 they say, well, you know, maybe this isn't exactly
22 right and there's not a problem with these, or --

23 MR. HARCKHAM: Objection.

24 A I've never been, I have no feel for
25 that. Never heard anything along those lines.

1 Q (By Ms. Reimer) Is that something we
2 should ask Mr. Danzer?

3 A Oh, I don't know. Of course you can,
4 I just --

5 Q Did I understand you correctly when
6 you said that Mr. Danzer assisted in this, in the,
7 with the customers and the process of discontinuing
8 the use of PCBs?

9 A I think we're, at least I see two
10 different issues here. One is the awareness that
11 PCBs are an environmental problem and the need to
12 prevent it from getting to the environment. The
13 other program is the notice that said starting as of
14 this day, we will no longer be able or were willing
15 to supply these PCB type heat transfer fluid. Two
16 different things.

17 Q Which one was Mr. Danzer involved in,
18 to your knowledge?

19 A He was involved with the conversion
20 program.

21 Q Thank you for clearing that up for me.
22 I'm just going to ask you a simple
23 background question. You testified that you've
24 earned a Bachelor's Degree and a Master's Degree,
25 have you also earned any type of certificates,

1 professional certificates of any type? I saw the
2 initials P.E. after the name on your card. What is
3 --

4 A Oh, Professional Engineer, I'm a
5 Registered Professional Engineer in the State of
6 Missouri, and in order to get that I had to pass an
7 examination, a written test.

8 Q Is the P.E. a series of tests or is it
9 just --

10 A I'm sorry?

11 Q To earn a P.E. do you take a series of
12 tests, or is it just one test?

13 A Mine was an all day affair, it could
14 have been a compressed series. There were different
15 documents handed to us throughout the day. Two in
16 the morning and one in the afternoon kind of
17 approach.

18 Q Did you have to take a course to study
19 for your P.E. exam?

20 A I did. I did.

21 Q Who did, who sponsored the course?

22 A The course was offered out at
23 Washington University on Saturdays, and it took
24 several Saturdays to complete.

25 Q When did you earn the P.E.?

1 A About 1963 or 4.

2 Q Pardon my ignorance, but is a P.E.
3 awarded in a specific area? Like you're a
4 Professional Engineer in the area of, or is it a
5 general type thing?

6 A It's a general registration. There
7 are some caveats about what you should really be
8 practicing in and where you can use your seal and so
9 on.

10 Q And just with respect to the P.E. that
11 you earned, were there any restrictions? In other
12 words, you're not like a civil engineer, right, you
13 wouldn't be designing roads and highways?

14 A No, I wouldn't do that because I'm not
15 trained in that.

16 Q Right. You relate more towards --

17 A Chemical engineering.

18 Q So when Mr. Hausman asked you about
19 the components and the makeup of certain Aroclors
20 and various chemicals, your knowledge was based on
21 your course of study?

22 A Yes.

23 Q Now, earlier you testified that
24 employees, when you were I believe the, in 1957 I
25 guess you were, became a plant, in charge of

1 engineering and maintenance at the plant?

2 A '57 --

3 Q Is that --

4 A Yeah, I was in maintenance, either a
5 supervisor or a superintendent, and I forget the
6 exact timing.

7 Q And you said that at that time you
8 were aware that any material handled in the plant
9 should not get in waterways? Did you make that
10 statement? The material handled in the plant
11 should, there were efforts made to keep it out of
12 waterways, water streams?

13 A As a Maintenance Supervisor?

14 Q Right. That one of your things was to
15 oversee the employees and make sure that the
16 materials at the plant were handled properly and
17 that they didn't escape into the waterways? Is that
18 --

19 A Not as a Maintenance Supervisor.

20 Q Then when was that?

21 A That thought followed all my
22 assignments, depending on how much waste my
23 activities were generating, and as a Maintenance
24 Supervisor, we didn't generate too many
25 opportunities for leakage. The production people

1 were supposed to drain the systems and get it ready'
2 for us to go to work on.

3 I was involved with this group that I
4 had mentioned that supports the operations with
5 delivery of goods and utilities and all that.

6 Q Let me, let me rephrase the question,
7 okay? And I'll take it out of the time context. I
8 believe you made the statement that any material
9 handled in the plant should not get into the
10 waterways, and employees were trained for the proper
11 handling of the material to prevent that from
12 happening.

13 A Yes.

14 Q And I believe you stated that every
15 employee knew that they should take steps or efforts
16 to avoid getting the product and the material into
17 the waterways?

18 A Correct.

19 Q Okay. Why was that? Why were such
20 efforts made to keep material from escaping into
21 waterways?

22 A It just strikes us that work with
23 chemicals that we don't want to see oil slicks in
24 water, and I think I mentioned the impact it would
25 have on the community's waste treatment plant, and

1 you can't ignore the fact that when you dump some
2 unknown chemical and it goes to a waste treatment
3 plant where the workers down there don't know what
4 you're sending them, you may be creating some health
5 problems. You don't know what others are sending
6 into that plant, and the mixing may create further
7 problems, so there's always this thought in mind.
8 In addition to upsetting the operation you can
9 introduce some health problems, and you can't ignore
10 the fact that economically it's wise not to lose
11 stuff down the sewer.

12 Q What if the sewer drain and waterways
13 led to a river or an ocean, not to a waste water
14 treatment plant?

15 MR. HARCKHAM: I object. I don't know
16 what you're asking him about, it's vague and
17 ambiguous.

18 A Well, we at Monsanto believe that you
19 cannot dump into the waterways because you don't
20 want fish kills, for example. You don't want
21 children swimming or wading in contaminated waters.
22 It just isn't good, not a good neighbor when you do
23 that to the community that you're operating in.
24 That's another thought that occurs to us.

25 Q (By Ms. Reimer) Is there anything

1 else you'd like to add?

2 MR. HARCKHAM: Objection.

3 A I don't know how to express it in
4 words except that this is perceived as being an
5 irresponsible act, if you just don't care and flush
6 it down the sewer.

7 Q (By Ms. Reimer) Okay, now, when you
8 say "it," are you referring to, let's say, materials
9 that have PCBs in it?

10 A Any material. PCBs included.

11 Q Whether it's PCBs or chlorides or
12 cyanides or fluorides or those chemical things?

13 MR. HARCKHAM: Objection.

14 A Even the materials you might perceive
15 as innocuous, they still shouldn't be flushed down
16 the sewer.

17 Q (By Ms. Reimer) Could I direct your
18 attention to Exhibit 2?

19 A Exhibit 2?

20 Q Yes. Now, I believe you testified
21 that you had seen documents like this one, not this
22 one in particular, but you had seen documents of
23 this nature?

24 A Yes.

25 Q Is that correct?

1 A Yes.

2 Q And when you were employed by Monsanto
3 starting in 1951, I believe?

4 A Yes.

5 Q Monsanto generated documents like
6 this?

7 MR. HARCKHAM: Objection.

8 Q (By Ms. Reimer) Of this nature, and
9 they did that through the course of your tenure at
10 Monsanto, correct?

11 A Correct.

12 Q And I believe you testified that this
13 particular document, to the best of your knowledge,
14 was passed around to the list on page 2? There's a
15 list of people it was distributed to, but that it
16 also could have been distributed to customers of
17 Monsanto?

18 A Yes.

19 MR. HARCKHAM: Objection, first of all
20 I object, I think it mischaracterizes earlier
21 testimony, and there's no foundation for the
22 underlying question.

23 Q (By Ms. Reimer) Well, the record will
24 speak for itself. Attached to the document on the
25 second to last page is an appendix. Do you see

1 that?

2 A I see it.

3 Q Is it your understanding that the
4 appendix would also be distributed to customers of a
5 document of this nature describing, this particular
6 one describes a Monsanto drawing from the phosphate
7 division for the detailed construction of a storage
8 tank for Aroclor 1254?

9 MR. HARCKHAM: Objection, lack of
10 foundation.

11 Q (By Ms. Reimer) While you were
12 employed by Monsanto through from 1951 through, I
13 believe you said 1986, so during your tenure, were
14 documents like this also prepared and disseminated
15 to the general public, customers?

16 MR. HARCKHAM: Objection, lack of
17 foundation.

18 A Yes, on a perceived need basis. It
19 isn't for every chemical, for every tank or, it does
20 change, but the intent was the same.

21 Q (By Ms. Reimer) Do you have any
22 knowledge as to whether Monsanto ever distributed a
23 document of this nature, not this particular one but
24 something like this, to the people up at Reynolds?

25 MR. HARCKHAM: Objection, lack of

1 foundation. Vague and ambiguous.

2 Q (By Ms. Reimer) Well, the first
3 question is do you have any knowledge.

4 A I don't have personal knowledge.

5 Q Who would have that type of knowledge?
6 Who is responsible for passing out this kind of
7 information when the requests were received? What
8 department or group or --

9 A Primarily the marketing representative
10 out in the field who calls on the customers with his
11 briefcase full of brochures and so on.

12 Q From 1951 to 1960, do you know who the
13 marketing representative of Monsanto was with
14 responsibility for Reynolds?

15 A I don't know that.

16 Q Do you know that for any period of
17 time during your tenure at Monsanto?

18 A No, golly. Unh-uh. I just don't
19 remember.

20 MS. REIMER: Thank you very much.
21 That's all I have.

22 THE WITNESS: Thank you.

23 (An off the record discussion was held
24 at this time.)

25

1 EXAMINATION BY

2 MR. HARCKHAM:

3 Q Mr. Papageorge, my name's Finley
4 Harckham, I'm representing Reynolds Metals in this
5 action and I'd like to ask you a number of
6 questions. Just so we're all clear, it's 5 now, I
7 imagine I'll be done probably in a half an hour to
8 an hour, do you want to continue with this at this
9 time?

10 A Sure. Yes. I'm ready.

11 Q I'd like to mark as Exhibit 36 a
12 multipage document with Bates numbers REY 001424
13 through 29.

14 (Defendant's Deposition Exhibit
15 Papageorge 36 marked for identification by the court
16 reporter.)

17 A I have scanned the exhibit.

18 Q (By Mr. Harckham) Do you recognize
19 this document?

20 A I do. I've seen it before.

21 Q Do you recall when you, when you first
22 saw it?

23 A Not vividly, no. It's just one of
24 hundreds of documents that are similar.

25 Q Okay. Do you know, was this, do you

1 know whether you saw this document in connection
2 with your work for Monsanto before 1970?

3 A Yes.

4 Q Do you know what this document was
5 used for?

6 A It was used to promote the use of
7 Monsanto's Aroclors and heat transfer systems.

8 Q And do you know to what groups or
9 categories of people this document was disseminated?

10 A Of course our marketing team, and in
11 turn their customers, both potential and current
12 customers received this.

13 Q Now, this document is dated September,
14 1949. Do you know how long it was in use by
15 Monsanto?

16 A Not specifically. It was at least ten
17 years, but I don't recall exactly when it was
18 revised or reissued.

19 Q Okay. On the first page, the very
20 first line references Aroclor 1248, and then the
21 second paragraph begins, "This bulletin describes
22 the physical properties of Aroclor 1248," and then
23 it goes on. Is it a -- we can strike that.

24 I'd like you to look, please turn to
25 page that's REY 1427?

1 A 27?

2 Q 1427, yeah, in the lower right hand
3 corner that's --

4 A I have it.

5 Q Okay. Do you see on the left hand
6 side of the page there is a, a heading, Freedom From
7 Toxicity Hazard?

8 A Yes.

9 Q Now, this, then there's a, there is a
10 series of four paragraphs below that. Have you seen
11 that language in other Monsanto documents? The
12 language that appears in these paragraphs below
13 Freedom From Toxicity Hazard?

14 A Yes.

15 MR. HAUSMAN: Object to the form of
16 the question. You're referring to the whole passage
17 or a specific part?

18 MR. HARCKHAM: The whole, the whole
19 passage.

20 A I have seen similar wording. In fact,
21 one of the exhibits from Dr. Kelly has that.

22 Q (By Mr. Harckham) Okay. And was, was
23 there a period of time that you recall in which
24 Monsanto promoted Aroclor 1248 as being free from a
25 toxicity hazard?

1 MR. HAUSMAN: Object on foundation.

2 A Yeah, the promotion involved not only
3 the material but the use in a heat transfer system
4 and in, under the proper conditions of use, the
5 toxicity hazard is substantially reduced, really
6 eliminated.

7 Q (By Mr. Harckham) I'd like to mark as
8 Exhibit 37 a multipage document with Bates number
9 MONS 078201 through 214.

10 (Defendant's Deposition Exhibit
11 Papageorge 37 marked for identification by the court
12 reporter.)

13 MS. RUTTER: Do you have a copy of
14 that for me, Mr. Harckham?

15 MR. HARCKHAM: I'm sorry. This is one
16 of the ones that we sent out before, but I do have
17 other copies. Here.

18 MS. RUTTER: Sent out for copying?
19 Thank you.

20 A I have scanned the article.

21 Q (By Mr. Harckham) Do you recognize
22 this document?

23 A It's been a while, but I, as I read it
24 or scanned it, it brought back some recollections,
25 yes.

1 Q First on the front page, it's kind of
2 hard to read the title. Can you take a shot at
3 that?

4 A It's Aroclor Resins and Plasticizers
5 for Chlorinated Rubber.

6 Q And then down below that it says
7 "Technical Bulletin" --

8 A "Technical Bulletin," and I just
9 cannot read the bulletin number.

10 Q Okay. Then it appears to say "May,
11 1959" below that, correct?

12 A I see that, yes.

13 Q Now, up, up at the top there is in
14 handwriting the word "obsolete." First of all, when
15 is it that you saw this document for the first time,
16 do you recall?

17 A I don't recall.

18 Q Was it during the period prior to
19 1970, do you know?

20 A I don't recall specifically, but I was
21 aware of many of these Aroclor brochures while I was
22 at the Anniston Plant, and that's as close as I
23 could get to the timing.

24 Q Okay. Now, this says "Technical
25 Bulletin" on the front and it's got a number. Was

1 there a series of Technical Bulletins published by
2 Monsanto?

3 A Oh, yes. Yes.

4 Q What was the purpose of publishing
5 these bulletins?

6 A Primarily to supply information to
7 customers and potential customers of Monsanto
8 products.

9 Q Do you know whether, whether these
10 bulletins were directly given to customers? As
11 opposed to the information, as opposed to being
12 given to Monsanto employees who then would
13 communicate with customers?

14 A Well, it varied with the Business
15 Director of the product involved. Some them would
16 have mailings when the brochure was just printed and
17 revised. Others would take the approach of sending
18 it to their field representatives, and the field
19 representative was expected to drop off the copies
20 personally and have a discussion with someone at the
21 site that he visited.

22 So it varied, but in any event, the
23 intent was to get it into, out there in the hands of
24 people who might find it interesting.

25 Q In 1959, did Aroclor resins and

1 plasticizers contain PCBs?

2 A Some of them. Because some of the
3 Aroclors were not chlorinated biphenyls. They were
4 not PCBs.

5 Q But some did contain PCBs?

6 A Yes.

7 Q I'd like to mark as Exhibit 39, 38,
8 I'd like to mark as Exhibit 38 a multipage document
9 bearing Bates numbers REY 000875 through 890.

10 (Defendant's Deposition Exhibit
11 Papageorge 38 marked for identification by the court
12 reporter.)

13 A I have scanned the exhibit.

14 Q (By Mr. Harckham) Okay. Do you
15 recognize this document?

16 A Yes, I have seen it before.

17 Q Do you recall roughly when you first
18 saw this document?

19 A Sometime about the period '65 to '70.

20 Q Do you know when this document was
21 generated? I didn't see a date, but if there's
22 anything about it that -- well, let me, let me ask
23 you, refer you to page 888, page at the bottom?

24 A 888.

25 Q Got that page? REY 888 in the lower

1 right.

2 A I see it.

3 Q Okay. Do you see under the heading
4 Take Ordinary Personal Care, it says, "Transformer
5 askarel has been made, handled and used for over 30
6 years without causing toxic or other ill effects."
7 Do you know when transformer askarel was first made?

8 A 1929 was the first application.

9 Q The year, with this reference to
10 askarel having been made and used for over 30 years,
11 does that mean that, does that date this document in
12 at least 1959 if that --

13 A The late '50s.

14 Q What, what was this document used for,
15 do you know?

16 A It was intended for the users and
17 owners of transformers with PCB type dielectric
18 fluids in them, especially for those who did their
19 own servicing of their transformers instead of
20 having someone come by and do it for them. It was
21 also intended for those service companies that were
22 involved in transformer maintenance, upkeep.

23 Q And when, when you saw this document
24 you think in the later part of the 1960s, it was in
25 use at that time by Monsanto?

1 MS. REIMER: Objection.

2 A Yes.

3 Q (By Mr. Harckham) So this document
4 had not been superseded by another document at that
5 time?

6 MS. REIMER: Objection.

7 MR. HAUSMAN: Without foundation.

8 A I don't recall any document that
9 covered this subject that superseded this document.

10 Q (By Mr. Harckham) And just so I'm
11 clear, this was a document that was given to
12 customers of Monsanto who used askarel; is that
13 correct?

14 MS. REIMER: I'm sorry, could you read
15 that back? I missed the question. I'm sorry.

16 Q (By Mr. Harckham) The question was is
17 this a document that was given to customers of
18 Monsanto who used askarels?

19 A It was given to customers of Monsanto
20 as well as customers of Monsanto's customers.

21 Q So for example, if GE sold a
22 transformer to customer X, this would go to customer
23 X as well as going to GE?

24 A If customer X was on Monsanto's list
25 of entities that purchased PCB fluids from Monsanto.

1 Q Okay. I understand. I'd like to mark
2 as Exhibit 39 a two page document bearing Bates
3 numbers MONS 098018 and 19.

4 (Defendant's Deposition Exhibit
5 Papageorge 39 marked for identification by the court
6 reporter.)

7 Q (By Mr. Harckham) The document
8 appears titled Data Sheet for Toxicological and Safe
9 Handling Information.

10 A I have read the document.

11 Q Do you recognize this document?

12 A I do not.

13 Q Okay. You see in the bottom of the
14 second page this document is dated March 31, 1961,
15 and it indicates that information was furnished by
16 Mr. Elmer P. Wheeler, Assistant Director, Medical
17 Department, Monsanto Chemical Company. I believe
18 you indicated before you know Mr. Wheeler?

19 A Yes.

20 Q Turning back to page, the first page
21 of this document, Item No. 4 says, of the form says,
22 "Procedure in Case of Breakage or Leakage," and then
23 the, what appears to be typed in is, "Clean up as
24 with any lubricating oil or hydraulic fluid."

25 Now, you understand this to be a

1 reference to Pydraul 150, which is listed up at the
2 top of this document?

3 A That's my understanding, yes.

4 Q Now, as of March 31, 1961 -- strike
5 that.

6 In 1961 did you have an opinion or a
7 practice as to how Pydraul should have been cleaned
8 up in the event of breakage or leakage? Breakage of
9 equipment or leakage of equipment?

10 MR. HAUSMAN: Objection, foundation.

11 MS. REIMER: Objection. You mean
12 Pydraul 150 or any kind of Pydraul?

13 MR. HARCKHAM: We'll say Pydraul 150.

14 A In 1961, the perception and
15 understanding was such that the advice typed there
16 in line 4 was appropriate.

17 Q (By Mr. Harckham) As Pydraul 150, in
18 1961, did that contain PCBs?

19 A Yes.

20 Q In 1961, in terms of your
21 understanding at that time, was this same procedure
22 appropriate with respect to any PCB containing
23 fluids?

24 MS. REIMER: Objection.

25 A Yes.

1 Q (By Mr. Harckham) I'd like to mark as
2 Exhibit 40, is it? A two page document bearing
3 Bates numbers MONS 071293 and 294.

4 (Defendant's Deposition Exhibit
5 Papageorge 40 marked for identification by the court
6 reporter.)

7 Q (By Mr. Harckham) Mr. Papageorge,
8 have you had a chance to review Exhibit 40?

9 A I have reviewed it.

10 Q Do you recognize this document?

11 A I have never seen it before.

12 Q Okay. Do you see in the bottom of the
13 second page it's dated January 15, 1963, and like
14 the last exhibit, it indicates that information was
15 furnished by Mr. Elmer P. Wheeler of Monsanto. In
16 1963, now, actually let me refer you back now to the
17 front page, where you see this document is dealing
18 with Pydraul AC?

19 A I do.

20 Q In 1963 did the Pydraul AC contain
21 PCBs?

22 A Yes.

23 Q And you see under No. 4, it says,
24 "Procedure in Case of Breakage or Leakage: Clean up
25 as with lubricating oil"?

1 A I do see that.

2 Q In 1963, was it your understanding
3 that that was an appropriate way to clean up Pydraul
4 AC that may have spilled?

5 MR. HAUSMAN: I object on foundation
6 and also vagueness.

7 A Based on the knowledge of 1963, that's
8 an appropriate statement.

9 Q (By Mr. Harckham) And was that an
10 appropriate statement based on 1963 knowledge with
11 respect to any PCB containing fluid?

12 A Yes.

13 MR. HAUSMAN: I'll object to the
14 question on breadth and vagueness grounds.

15 Q (By Mr. Harckham) I'd like to mark as
16 Exhibit 41 a multipage document with Bates numbers
17 REY 000919 through 950.

18 (Defendant's Deposition Exhibit
19 Papageorge 41 marked for identification by the court
20 reporter.)

21 Q (By Mr. Harckham) And this document
22 on the front says, "Monsanto, Monsanto Askarel,
23 Inspection and Maintenance Guide, Revised September,
24 1963"?

25 A I have scanned the exhibit.

1 Q Do you recognize it?

2 A Yes.

3 Q Do you know what, is this a Monsanto
4 publication?

5 A It is.

6 Q Do you know what it was used for?

7 A It was used to again share with
8 customers of Monsanto, or the customers of
9 Monsanto's customers who were involved with PCB
10 containing dielectric fluids, and it relates to the
11 maintenance of electrical equipment.

12 Q Do you know what, over what time
13 period this document was disseminated by Monsanto?

14 A Not specifically. I know that
15 periodically this subject was addressed in revised
16 issues of this type of brochure.

17 Q Do you know whether this brochure was
18 revised before 1970?

19 A Yes. Yes.

20 Q Do you know how much earlier than
21 1970?

22 A I really don't.

23 MR. HARCKHAM: Can we go off the
24 record for just a minute?

25 (An off the record discussion was held

1 at this time.)

2 Q (By Mr. Harckham) Mr. Papageorge, do
3 you know when Monsanto first informed its customers
4 of a possible environmental hazard associated with
5 PCBs?

6 A Monsanto in March of 1969 informed its
7 customers of huge volumes of PCBs, so it was a, it
8 was not all customers, it was a, a list of those who
9 purchased the most. They were informed of the
10 evolving evidence as it existed as of March 1969.
11 That was the first attempt to communicate the PCB
12 environmental issue.

13 Q Did that group include Reynolds
14 Metals, do you know?

15 A I don't believe so, no.

16 Q Were, was that group in March of '69
17 told, if you know, that there was an environmental
18 problem associated with PCBs, or was it just told,
19 I'm trying to get a sense of what they were told
20 about the situation. Were they told there was a
21 problem or were they told there were allegations or
22 what, what were they told?

23 MS. REIMER: Objection.

24 A The, as I recall the letter, it
25 informed them of the recent findings by some

1 laboratories throughout the world that a material
2 that was PCBs -- at that time it was not referred to
3 as PCBs, it was polychlorinated biphenyls -- were
4 found in samples taken from the environment, that
5 care should be taken not to let the PCBs escape to
6 the environment, and in essence, we'll let you know
7 more as we learn more. That's what that particular
8 letter indicated.

9 Q (By Mr. Harckham) Okay. What was the
10 next communication from Monsanto to its customers,
11 do you know?

12 A The next formal communication took
13 place in February of 1970 to all customers on record
14 with Monsanto of PCBs.

15 Q Let's mark as Exhibit 42 a two page
16 document bearing Bates numbers MONS 090210 and 211.
17 I don't know if the copies have already been given
18 out to everybody, or did you --

19 MS. RUTTER: I think I put them all
20 over there.

21 MR. HARCKHAM: I'm going to take off
22 what was stapled to the last page of this, numbered
23 non-consecutively.

24 MS. REIMER: Is it just a two page
25 document?

1 MR. HARCKHAM: I don't know whether
2 this additional thing belongs or not, but since it's
3 not in the same Bates range, I'm taking it off for
4 purposes of this exhibit.

5 (Defendant's Deposition Exhibit
6 Papageorge 42 marked for identification by the court
7 reporter.)

8 A I've scanned the document.

9 Q (By Mr. Harckham) Do you recognize
10 it?

11 A I do.

12 Q Is this the letter you just referred
13 to, February, 1970, to Monsanto's customers?

14 A This is one of similar letters, and
15 this particular one addresses the hydraulic fluids
16 sold by Monsanto that contained PCBs.

17 Q Was there more than one form of letter
18 that was sent out in February of 1970?

19 A It's, I don't know about the use of
20 the word "form." The subject was essentially the
21 same except that for the dielectric use, it referred
22 to the dielectric application. For the heat
23 transfer use, the different one, and for the, what
24 Monsanto called the plasticizer use, which was in
25 essence miscellaneous use, had another version.

1 Q Okay. Did you participate in drafting
2 the letters in their different versions?

3 A I did.

4 Q Do you see, well, can you, can you
5 read the letter and indicate what sections of this,
6 if any, were identical or substantively identical
7 among the different letters?

8 MS. REIMER: Objection.

9 A I don't propose to recall each and
10 every word, but --

11 Q (By Mr. Harckham) Right.

12 A The first paragraph for sure. My
13 reason for hesitating, I, I don't know how to
14 include in my comments or answer the reference to
15 the dielectric, the askarels that we talked about
16 earlier.

17 Q Maybe I can, maybe I can shortcut
18 this. Do you see the section, the paragraph that
19 begins on the first page, "We would like to point
20 out the following additional facts," and then No. 2
21 says, "PCBs with a chlorine content of less than 54
22 percent have not been found in the environment and
23 appear to present no potential problem to the
24 environment." Was that paragraph or that message
25 conveyed in each of the letters, if you know?

1 MS. REIMER: Objection.

2 A I'm trying to, I can't find it yet.

3 Q (By Mr. Harckham) Bottom of the first
4 page, numbered paragraph 2?

5 A Oh, okay. All right.

6 MS. RUTTER: By your question --

7 A That was included in all of the
8 versions.

9 Q (By Mr. Harckham) Of the February,
10 1970, letter?

11 MS. RUTTER: Yeah, I was just trying
12 to confirm on the record that you're talking about
13 February of 1970.

14 Q (By Mr. Harckham) Right. And that's
15 what you understood me to be talking about, was all
16 versions of the February, 1970, letter?

17 A Yes, that's my understanding.

18 Q And was that your under -- and is the
19 information stated in paragraph 2 here, was that
20 your understanding in February of 1970?

21 A Correct.

22 Q Just so I'm clear, Aroclor 124 -- does
23 Aroclor 1248 have a lower, have a chlorine content
24 of less than 54 percent?

25 A Yes.

1 MS. REIMER: Objection.

2 Q (By Mr. Harckham) It has a chlorine
3 content of 48 percent; is that correct?

4 A Yes.

5 Q Mr. Papageorge, when did Monsanto
6 first indicate on its product labels that there were
7 potential, there was a potential environmental
8 hazard associated with PCBs?

9 MS. REIMER: Objection.

10 MR. HARCKHAM: Your basis?

11 MS. REIMER: Foundation.

12 Q (By Mr. Harckham) Do you know when
13 Monsanto first indicated on labels, its product
14 labels that there was a potential environmental
15 hazard associated with PCBs?

16 A I do.

17 Q How do you know that?

18 A Well, I'm really the one that worded
19 the paragraph that was eventually placed on a, a
20 label that was affixed to the containers of material
21 that was shipped out.

22 Q Okay. And do you recall when that
23 label was affixed to containers, first affixed?

24 A The labeling program was implemented
25 in May of 1970.

1 Q I'd like to mark as Exhibit 43 a one
2 page document bearing Bates number MONS 098183.

3 (Defendant's Deposition Exhibit
4 Papageorge 43 marked for identification by the court
5 reporter.)

6 MS. RUTTER: Am I supposed, let's see,
7 I think I already have a copy of that.

8 MR. HARCKHAM: I think I gave out
9 copies of all these.

10 A I have reviewed the document.

11 Q (By Mr. Harckham) Do you recognize
12 this document?

13 A I do.

14 Q Is this a memorandum that was authored
15 by you?

16 A Yes.

17 Q And circulated to the individuals
18 listed at the top on or about April 13, 1970?

19 A Yes.

20 Q In the middle of the page there is a,
21 there's quoted language for a paragraph to be added
22 to the existing, it says to existing wording. Is
23 that, is that language to be added to the labels for
24 Aroclor packages? Is that what you were referring
25 to here in the letter?

1 A Yes. It's, the next paragraph says
2 which of the packages we had in mind at that moment.

3 Q Okay.

4 A Which was a partial list, really.

5 Q Okay. And do you recall whether the
6 quoted language here is in fact the language that
7 was placed on the labels in May of 1970 that you
8 referred to earlier?

9 A There was an additional word, the word
10 "extreme" was added before the word "care."

11 MS. REIMER: Can I just note for the
12 word that the document says there's an attachment
13 but the attachment isn't attached? On the bottom
14 left?

15 MR. HARCKHAM: Okay. Okay. It
16 appears that the attachment was going to be a copy
17 of the typical label, right? All right. That's not
18 a question.

19 MS. REIMER: Not a big deal.

20 Q (By Mr. Harckham) I'd like to refer
21 you back to Exhibit 31, please, that was marked
22 earlier?

23 A I have it.

24 Q You have it there? I'd like to refer
25 you to the first page, the second paragraph, the

1 second sentence that begins, "Our studies to date
2 have confirmed our suspicions that the higher
3 chlorinated biphenyls are more persistent than those
4 containing less chlorine."

5 Do you recall which, which chlorinated
6 biphenyls by number you were referring to as the
7 higher chlorinated biphenyls?

8 A That's the 1254 and higher.

9 Q In 1970 what, what were the different
10 uses of Aroclors? You mentioned heat transfer,
11 fluid, dielectric fluid, hydraulic fluid, what were
12 the other uses at that time?

13 A As an ingredient in paints and
14 varnishes and lacquers, an ingredient in adhesives,
15 an ingredient in caulking, as a plasticizer in
16 various plastic, and we saw earlier chlorinated
17 rubber application. The carbonless copy paper that
18 was popular back then had PCBs in it. It was
19 involved in some printing inks. That's all that
20 comes to mind at the moment.

21 Q And with respect to heat transfer
22 applications, was, were Aroclors used as a heater
23 for buildings, heating fluid for buildings?

24 A Yes.

25 Q They would go in a radiator?

1 A Yes, some buildings, yes.

2 Q And it was still used for that purpose
3 in 1970?

4 A Yes.

5 Q And was Aroclor used in food
6 processing?

7 A Yes.

8 Q In what ways, do you know?

9 A Primarily as a heat source to heat
10 cooking oils that are used in, say, potato chips and
11 fried fish and fried chickens, those kinds of
12 applications.

13 Q When you were in the plant in Alabama
14 in the late 1960s, did that plant have a waste water
15 effluent stream?

16 A Yes.

17 Q Was there any testing done of that
18 stream during the period you were Plant Manager
19 there to determine whether there were PCBs in that
20 waste water effluent?

21 A The analytical methodology available
22 then would never have picked up the small amount of
23 PCB in that water. The PCB, being heavy, would sink
24 to the bottom of the settling pond and combine with
25 the limestone bed that it was exposed to. Then that

1 bed, along with the PCBs, would be bulldozed out and
2 taken to a landfill.

3 So the water that left would be the
4 water that sort of decanted off of this pond, and
5 there was no methodology that would have picked up
6 the PCBs in that water.

7 Q Did there come a time later when you
8 learned that there were PCBs in that water?

9 A Yes.

10 Q When was that? When did you learn
11 that?

12 A I, the best I can say, about 1970,
13 after, after getting the methodology in place and
14 the instruments and taking samples and confirming
15 it, about 1970s.

16 Q How much, do you know how much PCB was
17 released in that waste water?

18 A No, I don't.

19 Q We have looked at a couple of
20 documents which, well, let me be specific. Let me
21 refer you back to Exhibit 42, please. You see that,
22 and again, back, the numbered paragraph 2 at the
23 bottom of the first page?

24 A Yes.

25 Q The sentence that says, "PCBs with a

1 chlorine content of less than 54 percent have not
2 been found in the environment and appear to present
3 no potential problem to the environment," for how
4 long was that your understanding?

5 A Oh, I would suggest that it lasted for
6 about a year. During 1970 more and more information
7 was coming in, so by the end of '70, early '71, the
8 lower chlorinated types were found in samples near
9 the users' plants. As distinguished from the pine
10 tree needle and the child's hair approach.

11 Q Right. Did you communicate that
12 information to Monsanto's customers? By you I mean
13 Monsanto.

14 A Not in a formal letter like this.
15 That was passed on in the normal course of a
16 followup on the PCB issue and used the, we used the
17 marketing people as our primary spokespeople.

18 Q And if I understand you, is that,
19 would that have begun in 1971?

20 A Late '70 for sure, and early '71, yes.

21 Q And do you know if that was
22 communicated to Reynolds Metals?

23 A I have an understanding that it was.
24 But I personally did not tell them myself.

25 Q What is your understanding of how it

1 was communicated to Reynolds?

2 A It seems that I, I recall that the
3 marketing team out of New York area calling on
4 Reynolds Metals, along with other customers, not
5 specific, not just, it's not isolated, just Reynolds
6 Metals, but they called on them and did mention the
7 latest, the status of the findings of all these
8 laboratories. That was being done so, so frequently
9 with customers that it became one of, nothing stands
10 out any more in my memory. Everybody was in on the
11 information chain.

12 Q In your job beginning in 1970 as the
13 Manager for Environmental Control, did you have an
14 occasion to give advice to any plant personnel
15 either at Monsanto plants or other plants as to what
16 to do in the event of a spill of a PCB fluid onto a
17 concrete floor?

18 A That was a frequently discussed
19 subject, yes.

20 Q What was your, did you give advice as
21 to how to handle that?

22 A I would give him what Monsanto was
23 doing. If it ended up on the floor, the primary
24 objective was to contain it so you maintain some
25 control of it, to avoid the impulse of grabbing the

1 hose and hosing it down the sewer, to use some
2 absorbent to capture it, and then to take that
3 material, whether it be sawdust or clay or sand,
4 take it to an approved burial site. The approved
5 sites, of course, varied from county to county and
6 state to state at the time.

7 The emphasis that I personally placed
8 was to avoid using detergents to scrub your floor
9 clean, and where possible, block your sewers and
10 preferably put curbing so that if there is a spill,
11 that it's contained in this miniature bathtub so you
12 can manage to control it more effectively. That's
13 the kind of discussion that came up many times.

14 Q I'd just like to follow up on some
15 questions that were asked before about when Monsanto
16 stopped producing PCB materials. Can you just give
17 a sort of a short chronology of, just so we, I'm
18 sure we have the complete story as to when the
19 different PCB containing materials were
20 discontinued?

21 A Shall I cover all of the uses, or just
22 those of interest to you?

23 Q I'd like all of them, please, if you
24 recall.

25 A All of them? I'll try. My dates will

1 not be pinpoint accurate, but. As of August 30,
2 1970, all sales to these uses that I am going to
3 call miscellaneous uses, the paint, the varnish, the
4 caulking, were terminated.

5 Q Okay. If I can interrupt you for a
6 second, were those the open uses you referred to?

7 A Yes.

8 Q In other words, not within a close,
9 the material was not used within a closed system?

10 A That is correct. The carbonless copy
11 paper took some technical effort to find a
12 replacement, so that didn't terminate until early
13 1971, about six months later.

14 Starting in '71 also, as I recall,
15 the, the use in heat transfer systems relating to
16 food was addressed and it was decided to stop
17 selling to a food applications and to convert those
18 units with a non-PCB replacement.

19 In late '71, '72 period the program
20 for finding alternative hydraulic fluids was in
21 place and the PCBs were replaced initially, because
22 we wanted quick action, with polychlorinated
23 terphenyls, which was the other member of the
24 Aroclor family.

25 Q Was this, you're saying it was late

1 '71 or '72, when were they replaced in terms of your
2 production?

3 A I think it was '71, '72 for a period,
4 about that time. There were some successes in
5 finding a phosphate ester for hydraulic fluids, and
6 therefore, Monsanto was able to drop the use of
7 chlorinated anything in its hydraulic fluids about,
8 about the middle of '71.

9 See, I'd have to look up some
10 documents to get those dates exact, but that was
11 kind of the transition. So we ended up really with
12 hydraulic fluids being replaced by phosphate ester
13 type formulations, the heat transfer fluids
14 essentially were successful in the food application
15 conversions. The program was started then in later
16 '71 to convert all heat transfer systems. So '72
17 was an active year for the conversion of heat
18 transfer systems to the replacement fluids that were
19 not fire resistant. Now, this involved, of course,
20 many technical changes in facilities, sprinkler
21 systems, dilute systems, and so on.

22 The dielectrics, a lot of effort was
23 placed by Monsanto and others to find a replacement
24 fluid, and the efforts were not successful. So the
25 dielectrics application continued up until Monsanto

1 just stopped selling PCBs in '77.

2 Q In that time period of 1970 to 1977,
3 did any government entity ever ban the sale of PCB
4 fluids for any application?

5 MS. REIMER: Objection.

6 MR. HARCKHAM: Basis?

7 MS. REIMER: Foundation.

8 A No.

9 Q (By Mr. Harckham) If they had done
10 so, did you make it your business to know what the
11 government's position was during that time period
12 about the sale of PCBs?

13 A Oh, yes. That was one of my major
14 projects was to get some guidance with government,
15 didn't see fit to do so. They condoned or
16 encouraged the continued use in electrical
17 equipment. Other than that, I found the government
18 was not very helpful. That's my personal
19 evaluation.

20 Q They didn't ban the use for any
21 application at that time?

22 A They did not ban until they passed the
23 Toxic Substances Control Act in 1976? I think that
24 was the date. And that act specifically mentioned
25 PCBs and called for a termination of manufacture and

1 sales in 1979. But Monsanto was able to terminate
2 in 1977.

3 Q When you were a Plant Manager in the
4 1960s, did your plant use chemicals produced by
5 other manufacturers, manufacturers other than
6 Monsanto?

7 A Oh, yes. Yes.

8 Q Did you expect at that time that if
9 there was a potential hazard associated with those
10 materials, that the manufacturer would bring that to
11 your attention?

12 A That was the --

13 MS. REIMER: Objection.

14 THE WITNESS: That was the
15 expectation, yes.

16 MR. HARCKHAM: Did you object?

17 MS. REIMER: Yeah, I did.

18 MR. HARCKHAM: What's the basis?

19 MS. REIMER: Vagueness, "potential
20 hazards," what does "potential hazards" mean to him
21 and you? I mean --

22 MR. HARCKHAM: If, for example, there
23 was a problem with a potential hazard of toxicity
24 associated with a chemical that you purchased in
25 that time period, would it be your expectation that

1 the manufacturer would provide you with information
2 about that hazard?

3 MS. REIMER: Objection.

4 THE WITNESS: That was the practice in
5 the industry. You expected some guidance. If you
6 didn't get it, you asked for it.

7 MR. HARCKHAM: Why don't we go off the
8 record for a minute.

9 (An off the record discussion was held
10 at this time.)

11 MR. HARCKHAM: Mr. Papageorge, I have
12 no further questions at this time. Thank you very
13 much.

14 THE WITNESS: Thank you.

15 EXAMINATION BY

16 MR. HAUSMAN:

17 Q Mr. Papageorge, I just have a few very
18 brief redirect questions, then I think we can all go
19 home.

20 Could you refer back to Exhibit No.
21 39, please?

22 A 39?

23 Q Yes.

24 A I have it.

25 Q Okay. Mr. Harckham referred you to

1 Entry No. 4?

2 A Yes.

3 Q You see that, where he asked you, I
4 think he used the word "appropriate," and that was
5 whether it was appropriate to clean up Pydraul 150
6 leaks or breaks as with any lubricating oil or
7 hydraulic fluid. Do you recall that testimony?

8 A I do.

9 Q Let me ask you this. In the time
10 period of 1961, were there, was it appropriate to
11 clean up lubricating oils and hydraulic fluids?

12 A Well, I can only speak for Monsanto's
13 practice, we would never flush lubricating oil or
14 baby oil, even, down the sewer.

15 Q Okay. Would you consider it
16 appropriate to allow lubricating oil or hydraulic
17 fluid to drain into a body of water?

18 A No. Not if you could avoid it.

19 Q Would you consider it appropriate to
20 allow lubricating oil or hydraulic fluid that had
21 been spilled onto the ground to remain there without
22 any cleanup?

23 A Are you talking about a pool of it or
24 a stain?

25 Q A stain.

1 A A stain? Monsanto would remove it if
2 it was a situation where storm waters would wash
3 through there and transfer that soil and move it on
4 into a water stream. If it was not that type of
5 situation, just leave well enough alone. Don't
6 disturb it because you're going to create problems.

7 Q Okay. If you could refer to Exhibit
8 42, please?

9 A 42?

10 Q Yes.

11 A I have it.

12 Q Mr. Harckham referred you to Entry No.
13 2 at the bottom of the page?

14 A Yes.

15 Q Okay. Is your understanding of the
16 statement under paragraph No. 2 that the reason that
17 PCBs with chlorine content of less than 54 percent
18 did not present a potential problem was simply
19 because that had not to date been detected in the
20 environment?

21 A Correct.

22 Q Okay. At any time either before this
23 letter or after this letter were you aware of
24 Monsanto communicating to any of its customers that
25 it was okay to release PCBs with less than 54

1 percent into the environment?

2 A No. It was never okay to release even
3 baby oil, if you want to make a comparison.

4 Q Okay. Thank you. Final question, are
5 you being reimbursed in any way for your testimony
6 today?

7 A I'm sorry?

8 Q Are you being reimbursed in any way
9 for your testimony today?

10 A No.

11 Q No consulting fees or anything?

12 A No, not in this situation, no. Not
13 for a fact witness.

14 MR. HAUSMAN: Okay. Thank you very
15 much.

16 MS. REIMER: I think we're finally
17 done.

18 MS. RUTTER: He'll read and sign.

19 (TIME NOTED: 6:12 P.M.)

20

21

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23

24

25

C E R T I F I C A T E

STATE OF ILLINOIS)

) ss:

COUNTY OF WILLIAMSON)

I, TARA SCHWAKE, Registered
Professional Reporter and Notary Public within and
for the State of Illinois, do hereby certify that
the foregoing deposition of WILLIAM PAPAGEORGE was
taken before me on the 16th day of July, 1997;

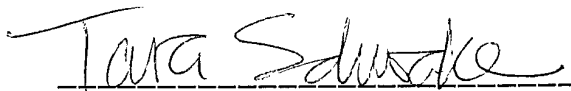
That the said witness was duly sworn
before the commencement of the testimony; that the
said testimony was taken stenographically by me and
then transcribed.

I further certify that I am not
related by blood or marriage to any of the parties
to this action nor interested directly or indirectly
in the matter in controversy; nor am I in the employ
of any of the Counsel in this action.

IN WITNESS WHEREOF, I have hereunto
set my hand this 28th day of July, 1997.

OFFICIAL SEAL

Tara Riley Schwake
Notary Public, State Of Illinois
My Commission Expires 8/25/97



TARA SCHWAKE

1
2
3 I, WILLIAM PAPAGEORGE,
4 have read the foregoing transcript and hereby
5 certify that it is a true and accurate transcript of
6 my testimony.

7
8 William Papageorge

9 WILLIAM PAPAGEORGE

10 State of Missouri
11 County of St. Louis

Sworn and subscribed to before me

12 this 18th day of August, 1997.

13
14 Jean M. Fuchs

15 NOTARY PUBLIC
JEAN M. FUCHS
16 NOTARY PUBLIC—STATE OF MISSOURI
ST LOUIS COUNTY
17 MY COMMISSION EXPIRES AUG. 18, 2000
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25

Corrections:

Page - Line

Page 59 Line 10

Word or phrase: nitrochlorobenzene

Corrected to: penta chloro phenol

Page 138 Line 13

Word or phrase: impression

Corrected to: impressive

Page 206 Line 21

Word or phrase: dilute

Corrected to: deluge

Word or phrase: _____

Corrected to: _____

Word or phrase: _____

Corrected to: _____

Word or phrase: _____

Corrected to: _____

Word or phrase: _____

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Dated August 18, 1997

Witness Signature: William Papa-George

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Lawyer's Notes

chlorine and that an allowable concentration of 1 mg./cu. meter would be reasonable for the chlorinated diphenyl containing approximately 55 per cent chlorine.

Oral Toxicity. Drinker¹³ reported oral toxicity studies on chlorinated diphenyl containing 65 per cent chlorine. Feeding rats at 0.5 g./day, the first animal died in 9 days; 4 more by the end of the month. Liver lesions were found in these animals similar to those seen from vapor exposure.

Miller¹² fed chlorinated diphenyl to animals. His diphenyl contained 42 per cent chlorine and was approximately equivalent to 3 atoms of chlorine per molecule. Two doses, each dose 0.05 ml. (60 mg.), were given to guinea pigs 1 week apart. Death occurred in 11 to 29 days. The livers showed metamorphosis and central atrophy. Rats received 25 daily doses of 0.1 ml. (130 mg.). These animals survived the administration and were killed at 10-day intervals from 30 to 90 days after the beginning of the feeding. They showed the typical liver injury seen in the other animals.

Skin. Miller¹² also applied the same chlorinated diphenyl to the skin of guinea pigs, rats, and rabbits. Guinea pigs received 11 daily skin applications of $\frac{1}{10}$ of 1 ml. (34.5 mg.) of undiluted chlorinated diphenyl. The animals died at various intervals up to 21 days after the first application. Histopathological examination of the liver showed fatty degeneration and central atrophy. The kidney was essentially normal. There was a thickening of the epidermis at the site of application.

Rats were given 25 daily applications of the same dose, $\frac{1}{10}$ ml. (34.5 mg.) of undiluted chlorinated diphenyl. They survived the application. The animals were killed at 10 day intervals beginning with 30 days and ending at 90 days after the initial treatment. Histopathological examination of the liver showed only slight changes. The treated skin was much thickened and hair follicles were swollen.

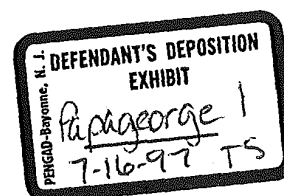
Rabbits received skin applications at 2-day intervals. They were given 80 mg./day for the first 7 applications and 172 mg. for the last 8 applications of undiluted chlorinated diphenyl. Death occurred between 17 and 93 days. Fatty degeneration and central atrophy of the liver were more striking in these animals than in the previous animals. The treated skin showed a thinning of the prickle cell layer and a relative thickening of the outer cornified layers.

Human Experience. A number of the references recorded under chlorinated naphthalenes also discussed chlorinated diphenyls. It is difficult to determine the role played by the chlorinated diphenyls as, in most instances, they were mixed with chlorinated naphthalene. Jones and Alden¹⁴ reported on human cases working with chlorinated diphenyls. They observed a typical acneiform dermatitis among workers handling this material. As these workers were manufacturing the material from crude coal tar distillates, these authors were inclined to feel that other chlorinated aromatic materials present which were considered to be more unstable might be the more important cause of the dermatological response. The workers

¹³ J. W. Miller, *Public Health Repts. U. S.*, 59, 1055 (1914).

¹⁴ J. W. Jones and H. S. Alden, *Arch. Dermatol. and Syphilol.*, 83, 1022 (1926).

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did not get a typical neneform dermatitis from patch tests. This is not surprising as a number of authors recognize that it is necessary to have a long-term exposure to this material in order to get this typical response. It is quite possible that high chlorinated aromatic materials from the crude coal tar distillates may also cause neneform dermatitis. It is quite probable, however, that the dermatitis can also be observed following exposure to the highly chlorinated diphenyls.

4. Hygienic Standards of Permissible Exposure

The threshold of chlorinated diphenyls was established by the American Conference of Governmental Industrial Hygienists, in April, 1959, at 1.0 mg./cu. meter for chlorodiphenyl (42 per cent chlorine) and 0.5 mg./cu. meter for chlorodiphenyl (54 per cent chlorine).

CHLORINATED NAPHTHALENES, $C_{10}H_{(8-n)}Cl_n$

1. Uses and Industrial Exposures

The chlorinated naphthalenes do not occur in industry as individual compounds. They will, therefore, be treated as a group. Any one product is a mixture but will have a specific range of chlorine substitution. Those with three or less chlorine equivalents are much less toxic than those with four or more.

These materials are used in electric wire insulation. They have also been used as additives to special lubricants.

The first problems were encountered in the use of these materials in wire insulation. Skin problems may arise from contact with the cold material. The hot material and, particularly, the vapors, may cause serious systemic poisoning as well as acne.

Injury to farm animals has occurred when lubricants containing the chloronaphthalenes were ingested. This may occur when cattle feed becomes contaminated from the machinery in which it is processed, or from similar lubricants used in farm machinery.

2. Physical and Chemical Properties

Physical state: Waxy solids

Properties vary with the degree of chlorine substitution

Solubility: insoluble in water; soluble in organic solvents

3. Physiological Response

When the higher chlorinated naphthalenes are absorbed they cause severe injury to the liver characterized as acute yellow atrophy. The systemic injury appears to be exclusively one of liver injury. Injury may occur from ingestion or from breathing hot vapors. Some authors have indicated that chlorinated naphthalenes may also be absorbed through the skin.

The other most striking response to contact with the chlorinated naphthalenes is chloracne. This usually occurs from long-term contact with the material or from a much shorter contact with hot vapors. The reaction is usually slow to appear and may take months to return to normal.

The third problem that has arisen from industrial use of chlorinated naphthalene has been hyperkeratosis in cattle. Special lubricants containing the chlorinated naphthalene were used in machinery for pelleting feeds. Externally, there is a thick keratinized layer on the skin of the neck, shoulders, and the withers. The gall bladder, liver, pancreas, and kidneys are affected. The condition is often fatal. While the most common cause has been from grease that contaminated pelleted feeds from the pelleting machinery, the same condition can occur from the ingestion of special oils or greases used on farm machinery if they contain the chloronaphthalene.

Vapor Exposure. Drinker *et al.*¹² exposed rats to vapors of chlorinated naphthalenes. As the material has a high boiling point and had to be heated to vaporize, it is possible that a certain amount of material may be condensed either on the cage or on the animal so that there may have been some oral intake. Animals were exposed for 16 hours/day. In a case of lower chlorinated material represented largely by a mixture of tri- and tetrachloronaphthalene, an average concentration of 1.31 mg./cu. meter of air essentially produced no effect other than a possible slight enlargement of the liver. The same material at a concentration of 10.97 mg./cu. meter resulted in a slight liver injury. Exposure was repeated daily for up to 4½ months.

Similar exposure to the vapors of a mixture of penta- and hexachloronaphthalene at an average concentration of 1.16 mg./cu. meter produced definite liver injury. At a concentration of 8.83 mg./cu. meter, there was some mortality, poor growth, and severe liver injury. The higher chlorinated material showed a greater toxicity than the lower chlorinated material.

Clinical cases of systemic injury from this material have been reported by a number of authors. Sometimes the illness was preceded by skin lesions and sometimes it was not. It is implied that the systemic poisoning was largely due to breathing vapors. The following references are pertinent.¹³⁻²³

Oral. Drinker *et al.*¹² fed a mixture of penta- and hexachloronaphthalene at a rate of 3 g./day to rats for 1 month. Nine out of 10 animals died. They all lost weight, were sick, and showed severe liver injury. When a mixture of tetra- and pentachloronaphthalene was fed at a dose of 0.5 mg./day for 2 months they observed some sickness, some mortality, and definite liver injury.

¹² L. Greenberg, M. R. Mayers, and A. R. Smith, *J. Ind. Hyg. Toxicol.*, 21, 29 (1939).

¹³ M. R. Mayers and A. R. Smith, *N. Y. State Ind. Bull.*, 21, 30 (1912).

¹⁴ N. G. McLachlan and D. Robertson, *Brit. Med. J.*, 1, 611 (1912).

¹⁵ E. C. Riley, *N. Y. State Ind. Bull.*, 22, 50 (1913).

¹⁶ L. Greenberg, *J. Ind. Med.*, 12, 520 (1913).

¹⁷ L. Greenberg, *J. Ind. Med.*, 22, 101 (1913).

¹⁸ L. H. Cutler, *J. Am. Med. Assoc.*, 123, 273 (1914).

Skin. The most commonly observed problem from the use in handling of chlorinated naphthalenes is the chloracne. This has been observed on the skin of workers from a number of operations where it has been used. Most of the clinical reports listed previously under vapor exposure also include studies of chloracne. A detailed discussion of dermatological problems has been published by Good and Pensky.²⁴ The clinical aspects of this skin problem were also discussed by Schwartz.²⁵ Another extensive report was given by the special bulletin of the State of Pennsylvania.²⁶

Adams *et al.*²⁷ studied the nature of the response of rabbit's skin to this type of material. They concluded that the response takes the form, first, of epithelial hyperplasia, second, inflammatory and degenerative changes, and, finally, regenerative processes.

This work is particularly interesting when we consider the nature of the hyperkeratosis observed in cattle. This is described in some detail in Leaflet No. 355, U. S. Dept. of Agriculture, 1954. There is apparently a hyperplasia and a keratinization. It is noticeable in the neck, shoulders, and withers. There are also growths on the gums of the animal. This is also discussed by Bell,²⁸ and was first described by Olafson.²⁹

This condition in animals is supposedly due to ingestion. The injury to the liver and obvious systemic effect certainly would indicate that it is an important factor. It is possible, however, considering the reaction of the tissues of the mouth, cheek, and neck, that some of the material may act by direct contact with the mouth and skin.

Absorption and Metabolism. Cleary *et al.*³⁰ published an article on the absorption and metabolism of the chlorinated naphthalenes. They indicated that the material was readily absorbed from an olive oil solution. They found no evidence of storage in the lung, liver, skin, or kidneys. They did not find any excretion via the urine and concluded that the chlorine might be removed from the ring and excreted as chloride. They observed a rise in urinary ethereal sulfate. There was no change in neutral sulfur.

4. Hygienic Standards of Permissible Exposure

Drinker¹⁸ proposed the following limits for the chlorinated naphthalenes: trichloro—49.9 per cent chlorine (10.0 mg./cu. meter); tetra and penta—56.4 per cent chlorine (1.0 mg./cu. meter); penta and hexa—62.6 per cent chlorine (0.5 mg./cu. meter). The A.C.G.I.H. 1961 threshold for trichloronaphthalene is 5 mg./cu. meter; for pentachloronaphthalene is 0.5 mg./cu. meter.

²⁴ C. K. Good and N. Pensky, *Arch. Dermatol. and Syphilol.*, 48, 281 (1913).

²⁵ L. Schwartz and S. M. Peck, *N. Y. State J. Med.*, 43, 1711 (1943).

²⁶ Commonwealth of Penn. Dept. Labor & Ind., *Spec. Bull. No. 43* (1936).

²⁷ E. M. Adams, D. D. Irish, R. C. Spencer, and V. K. Rows, *Ind. Med. Ind. Hyg. Section*, 1, 1 (1941).

²⁸ W. R. Bell, *Vet. Med.*, 48, 135 (1953).

²⁹ P. Olafson, *Cornell Vet.*, 27, 106 (1947).

³⁰ R. V. Cleary, J. Maier, and G. H. Hitchings, *J. Biol. Chem.*, 127, 403 (1939).

Cement and Concrete

Cement is made from cement rock or a mixture of finely ground limestone, or other form of calcium carbonate, with clay, shale, slate, or blast furnace slags, rarely sandstone, and certain accelerators or retarders. The mixed powders are heated in a kiln, usually rotary, to about 1300 to 1400°C. The kilns are heated by fuel jets of powdered coal, gas, or oil. The cement rock rarely contains more than 6 or 8 per cent quartz; the finished product usually less than 1 per cent, though occasionally it may contain up to 6.5 per cent. The dusts are ordinarily classed as nuisance dusts but their concentration may exceed the most liberal ideas of permissible limits.

There are several dust-producing operations and they are amenable to control measures. Some of these sources are: stone quarrying, crushing, grinding, the rotary kiln, screens, bagging operations, and the loading and unloading of cars. Dust clouds, if uncontrolled, not only are conducive to undesirable working conditions but also constitute an atmospheric pollution nuisance in the community. Electrostatic precipitation as well as centrifugal collectors have been used successfully to remove the dust from the effluent air from kilns and silos, and the amount recovered is said sometimes to exceed 5 per cent of total raw materials. A method that has been successfully applied to the rotary kiln elsewhere (see Sand Refining) is to exhaust the hot kiln gases through baffled water-spray chambers and conduct the water flowing from the sprays through a settling basin from which the sludge may be recovered. The important factors in evaluating exposures are the degree of dust control and the free silica content of dust particles less than 5 μ in diameter. Lung injury from exposure to cement dust, however, has not been demonstrated and the most frequent, harmful result of exposure is that of skin irritation from the alkaline action of cement. In the mixing and use of concrete, the irritant, alkaline action of the wet mixture is similar to that of the cement dust, and both warrant suitable control to prevent prolonged contact with the skin.

Chlorinated Waxes and Oils

Synthetic Chlorowaxes. The synthetic chlorowaxes comprise a number of chlorinated hydrocarbons that are derivatives of naphthalene or diphenyl. Halowax is the trade name of one manufacturer for the chlorowaxes.

The damage that may occur from inhalation, ingestion, and skin absorption of the chlorowaxes will vary with the degree of chlorine saturation of the compounds. The amount of dermatitis and poisoning increases rapidly as the amount of chlorine in the waxes increases. The commonly accepted maximum permissible limit for atmospheric contamination with trichloronaphthalene is 5 mg. per cubic meter of air. Pentachloronaphthalene, one of the chlorowaxes carrying a high percentage of chlorine is restricted to 0.5 mg. per cubic meter of air.

Systemic poisoning from the chlorowaxes is generally characterized by damage to the liver. Serious exposure may produce acute yellow atrophy. The

skin effects are commonly in the form of acne, which is more widely distributed on the body than common acne.

Among the recommendations for the prevention of chlorowax poisoning are: (1) vapors and dust should be controlled by exhaust ventilation to prevent exposure to amounts of the compounds in excess of the safe limits mentioned above; (2) foremen and workers should be told of the toxicity of the materials that they are handling and instructed to keep skin contacts with the material to a minimum; (3) preemployment and periodical physical examinations should be given with special attention to the skin and to the liver, liver function tests being performed periodically; and (4) the best hygienic conditions should prevail, including the provision of clean work clothing, protective gloves, and protective creams. Those manufacturers who have had the most favorable results in preventing chlorowax poisoning have provided double locker rooms, one for street clothes and one for work clothes, with a shower room in between. The workers should be required to take a shower every day before leaving the factory; it is well to provide supervision to make certain that this practice is complied with.

Air analysis for the chlorowaxes is most commonly performed by passing the air over heated platinum in an electrically heated quartz tube; the waxes decompose and the effluent gas is scrubbed in a column of glass beads moistened with sodium carbonate; the chlorine is converted to sodium chloride which is recovered by washing the beads, and is usually determined nephelometrically. The impinger, using amyl acetate as the collecting medium, has also been employed for collection of samples; afterward the samples are burned, products of combustion collected and chlorides determined.

Chlorinated Oils. There are two general types of oils falling within this class: the first contains additive substances such as carbon tetrachloride to improve cutting properties; the second has chlorine combined in complex organic structure.

The chlorine additive agents may be recovered by distillation and are released from the oils in accordance with vapor pressure laws. The use of oil plus chlorinated hydrocarbon may be hazardous unless exhaust ventilation is provided. Nausea and malaise are common complaints of workers handling the mixtures. The haphazard methods used in preparing the mixtures tend to increase the danger. Commonly the chlorine compound is added in unknown proportion as an antidote for cutting difficulties. In some instances the mixture has been found to contain as much as 40 per cent carbon tetrachloride.

The chlorine in the second type of oil is firmly bound at lower temperatures; upon heating, little decomposition occurs below 200°C.; near and above 250°C. hydrogen chloride is evolved. It is known that temperatures in excess of 300°C. are produced locally from heavy cutting operations. This type of oil probably can be used safely for light precision machining.

Animal experimentation has shown that chlorine compounds in oils may be absorbed through the intact skin to cause liver damage. Dermatitis from chlorinated oils also occurs.

MONS 076170

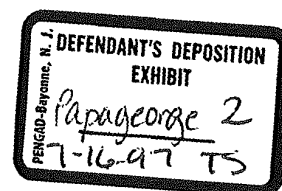
GENERAL INFORMATION
CONCERNING THE HANDLING
OF
AROCIOR 1254

By
W. E. Alexander

Monsanto Chemical Company
Phosphate Division Engineering Department
Anniston, Alabama

December 1, 1941

MONS 060030



WATER_PCB-SD0000064087

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MONS 060031

I N D E X

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Hazards	2
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B. Storage Tanks and Handling Equip- ment	2, 3
C. Tank Cars, Their Unloading, Return, Etc.	4

A P P E N D I X

MONS 060032

A. GENERAL

Characteristics of Aroclor 1254

Form: Yellow tinted viscous oil.
Color: A.P.H.A. 150 maximum.
Acidity: (N₂m. KOH per gram) 0.01 maximum
Coefficient of Expansion: 0.000661 cc/cc/deg.C. (25 deg. - 65 deg.C)
0.000367 cc/cc/deg.F. (77 " -149 " F)
Density - Specific Gravity 25 deg./25 deg.C : 1.538 to 1.548
1.48 at 80 deg. C
1.40 at 160 " C
Pounds per Gallon: 12.83 at 25 deg. C.
Distillation Range - ASTM-D-20 Mod: 365 deg. - 390 deg. C
689 - 734 " F
Evaporation Loss - ASTM-D-6 Mod: 163 deg.C. - 5 hrs. - 1.06 to 1.28%
100 " C - 6 " - 0.4% maximum.
Flash Point: None
Fire Point: None
Pour Point: 8 deg. to 12 deg. C.
46 " to 54 " F.
Viscosity - Saybolt Universal Seconds (ASTM-D-88)
210 deg. F (98.0 deg. C) 43.5 - 48.5
130 " F (54.4 " C) 260 - 400
100 " F (37.8 " C) 1800 - 3800
Thermal Conductivity: 0.22 cal./gm./deg.C. at 0 deg. C
0.365 " /gm./deg.C. at 100 deg. C.
Vapor Pressure: 7 mm.Hg. at 200 deg. C.
80 mm.Hg. at 275 " C.
520 mm.Hg. at 350 " C.
Solubility: Insoluble in water. Readily soluble in most organic
solvents. Slightly soluble in the common alcohols.
Resistivity: 100×10^9 at 100 deg. C. minimum. (Ohm Cm.)
Dielectric Constant: 4.15 - 4.35 at 100 deg. C.
Refractive Index: 1.6370 to 1.6390 at 25 deg. C.

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Hazards

The fumes from Aroclor 1254 are quite obnoxious and are, when inhaled excessively, dangerous and hazardous. When handling this material in relatively closed areas, ample ventilation (hoods in extreme cases) should be provided for removal of the fumes from the working area. The fumes attack the mucous membranes of the nasal passages and irritation of the membranes and slight lung congestion may result from excessive inhalation of the fumes.

The handling of Aroclor is carried out at temperatures ranging from 75 deg. C. to 130 deg. C., thus presenting a minor hazard of burns resulting from contact with the hot liquid. Such burns require no special treatment.

Precautions in Handling

Aroclor 1254 will readily absorb traces of moisture. It is essential that the material be kept from contact with water. All air coming in contact with the Aroclor should be properly dried by passing through a dehumidifying unit such as a calcium chloride breather, activated alumina breather, or other similar dehydrating agent units. Calcium chloride breathers on all storage and handling tanks have been found to be completely satisfactory.

B. STORAGE TANKS AND HANDLING EQUIPMENT

Although Aroclor 1254 is but slightly corrosive to metals, it promotes corrosion (by oxidation) of iron and steel. Hence, no handling equipment should be of steel construction where it comes in contact with Aroclor. All process piping handling Aroclor must be galvanized. All wetted pump parts must be either stainless steel or bronze. (Worthington Worthite pumps have been found to be completely satisfactory for this service.)

Storage and handling tanks may be of steel construction if properly metallized with zinc, tin, or aluminum on the interior surfaces coming in contact with the Aroclor. The metallizing should be done according to the following procedure:

1. Clean an area of the surface by sandblasting, or a similar method, to give a perfectly clean and roughened surface. The area cleaned should not be greater than can be completely metallized within a few hours after cleaning.

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2. If zinc - tin metallizing is used, a coating of zinc 0.005 inches thick should be sprayed on the cleaned surface. This is followed immediately by a coating of tin 0.007 inches thick.
3. Metallization with aluminum has been found acceptable.

All storage and handling tanks should be amply provided with dehumidifying breathers such as calcium chloride, activated alumina, etc. units. This is essential in order to prevent moist air from coming in contact with the Aroclor. A moisture content above 35 p.p.m. adversely affects the dielectric constant and the resistivity of the Aroclor.

Storage tanks must be provided with ample heating coil surface to supply sufficient heat to the material to bring it to the proper temperature for pumping, etc. Heating coils should be either metallized steel, or, preferably, steel coils which have been galvanized after fabrication. It is recommended that the steam pressure on all heating coils should not exceed 100 pounds per square inch gage; lower pressures should be used where practicable. It is essential that all steam coils be completely free of even minute leaks, since this would introduce water into the Aroclor.

Before a newly constructed storage tank is filled with Aroclor, it should be heated to a temperature of at least 100 deg. C. to expel the moist air. The new tank should be dried as much as is possible before charging. It would be beneficial to heat the tank, allow it to cool and pull in dry air through the dehumidifying breather, heat again, etc., until the tank is full of comparatively dry air before the initial filling of the tank is started.

Aroclor 1254 must be heated to 75 deg. C to 90 deg. C. for pumping or other transportation through pipe lines, etc. When extremely rapid handling is desired, it is permissible to heat the material up to 130 deg. C. It is not advisable to hold the material at such temperatures over extended periods of time, however.

All handling pipe lines must be traced with steam lines and insulation applied over the two lines in order to keep the handling lines and the material up to the desired pumping temperature.

MONS 060035

C. TANK CARS, THEIR UNLOADING, RETURN, ETC.

Aroclor 1254 is shipped in two types of tank cars, both of which are either aluminum lined or zinc - tin metallized. One type of tank has the heating coils inside the tank which are in direct contact with the Aroclor. The other type of tank is a double shell tank with heating coils between the inner and outer shells. Both types of tank are tested for 60 pounds pressure and their steam coils are tested for 200 pounds.

Before unloading the Aroclor, it is necessary to bring it to pumping temperature in the tank car. The steam coil outlet may be either trapped or throttled with a valve. It is recommended that steam pressures be limited to 100 pounds, particularly in the case of the coils being in direct contact with the Aroclor. It will require from 6 hours to 12 hours to bring the material to pumping temperature (75 deg. C. to 130 deg. C.), depending on weather conditions. After the tank car is emptied, the steam coils must be blown clear of water and properly capped.

Aroclor 1254 must be unloaded by displacement with dry air. There are either two or three connections on the tank car dome, depending on the car type. When three connections are found, there is one 2 inch unloading connection which extends to the bottom of the tank, one 1 inch air inlet connection, and one pressure safety vent which is adjusted to release any pressure in excess of 60 pounds. The vent connection is hooded for protection. When only two connections are found, one is a 2 inch unloading connection and the other is the safety vent. In this case, it is necessary to remove the safety vent and introduce the displacement air through that connection. When unloading is complete, all connections must be replaced as received. It is requested that the empty tank be sealed immediately after the connections are broken in order to keep the tanks filled with dry air during return shipment.

It is essential that the displacement air used for unloading be thoroughly dried by some dehumidifying unit such as a calcium chloride, activated alumina, or similar dehydrating agent drying unit. Required air pressures for unloading will depend upon the layout of the unloading system.

An unloading dock with proper piping connections should be provided at the railroad track where the Aroclor is to be unloaded. This dock should be provided with the connection to the discharge piping, the displacement air piping, and suitable steam connections for use on the steam coils.

MONS 060036

APPENDIX

ADDITIONAL INFORMATION CONCERNING THE HANDLING OF AROCLOR 1254

Attached to this copy of this report is Monsanto Chemical Company, Phosphate Division; Drawing No. 9C-8170-5 showing the detail construction of a 15,000 gallon storage tank for Aroclor 1254. This construction has been found to be completely satisfactory and is, to the best of our knowledge, the best construction for this service.

The various nozzles on this tank are used as follows, considering them in order from left to right on the drawing:

- | | |
|---------------------|---|
| 3" nozzle | - Inlet for recirculation. |
| 24" nozzle | - For future agitator if required (not used). |
| 3" nozzle | - For calcium chloride breather connection. |
| 36" manhole | - For inspection, etc. Float gauge located in center of this manhole. |
| 3" nozzle | - Not used. |
| 24" nozzle | - For future agitator if required (not used). |
| 3" nozzle | - Not used. |
| 3" nozzle | - Filling inlet connection. |
| 18"x26" Oval nozzle | - For sump pump. |
| 3" nozzle | - For thermometer well (see detail). |

The two 24" nozzles were originally installed for installation of agitators if required. However, it has been found unnecessary to use agitators in the storage tank, and these nozzles could be omitted from storage tanks where extreme agitation is not required.

It has been found that circulation of the Aroclor by the sump pump, and into the nozzle on the opposite end of the tank, for several hours gives satisfactory blending of the tank contents.

For pumping Aroclor 1254 from the storage tank, a Taber Pump Company all bronze 2-1/2" x 2" vertical pump (Figure 1940) with Monel shaft has been found to be quite satisfactory for the application. Further details and specifications for this pump will be furnished on request.

MONS 060037

APPENDIX

P.2

The liquid level gauge used in the storage must be gas tight. The Monsanto Arcolor 1254 storage tanks are equipped with Vapor Recovery Systems Co. "Varec", Fig. 253 gas tight automatic tank gauge. Further details and specifications for this level indicator will be furnished on request.

It is recommended that the stored Arcolor be filtered through a filter press using paper before using in order to remove any foreign matter such as scale, etc. Details of a suitable filter can be furnished on request.

The storage tank should be provided with an operating platform suitable to the customers conditions of operation.

A dock for unloading should be provided at the tank car unloading location. This dock can be constructed to conform to other loading or unloading docks used by the customer. Detail prints of loading docks used by Monsanto will be furnished on request.

The dehumidifying unit used as a breather on the storage tank can be of any suitable construction. Calcium chloride breathers constructed as shown on Monsanto Chemical Company, Phosphate Division, Drawing No. 9C-8248 (attached) have been found satisfactory. The upper portion of the chamber is charged with anhydrous calcium chloride. Periodic inspection of the calcium chloride will show the formation of a cake of damp material on top about 1 to 1 1/2" deep. This cake should be removed and fresh material recharged. Any suitable construction similar to that shown on Drawing No. 9C-8248 may be used for the breather units.

"TA:ms

MONS 060038

Mr. N.G.H. Thomas.

14/12/49

Mr. W.H. Ritchie.

AROCLORS-TOXICITY
ARMSTRONGS PATENTS LTD.

WHR/JS:

c.c. Dr. J.W. Barrett—
Dr. J.A. Gardner
Dr. H.R. Newman.

It should be stressed to Armstrongs that the use of Aroclors in die-casting machines has been well established for some years in the States. Beyond the precautions given in the bulletin our Medical Department in St. Louis has never given any extra warnings or shown alarming concern over the use of Aroclors.

Dr. Newman and myself are of the opinion that the greatest danger lies in the inhalation of the vapours at high temperatures, and to this end we suggest that you advise Armstrongs Patents as we did Armstrong Siddeley, namely,

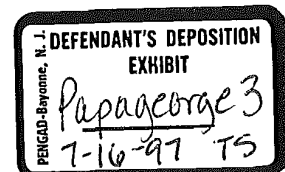
- (1) Lateral exhaust ventilation at the point of usage, using a velocity of 1000 f.p.m.
- (2) Adequate ventilation of the room as a whole.
- (3) Strict personal hygiene.

For maintenance work on which the engineers may come in contact with the cooled liquid we would advise good covering overalls (to be changed and washed as soon as the job is finished), rubber gloves, and for the time being a barrier cream. This should be as in the bulletin or based on a cream containing Lanoline up to 70%. Dr. Newman is uncertain as to the absorption of aroclors through the cream but feels that the cream will give better protection than the bare skin. We do not advise the use of the cream after coming in contact with the Aroclor.

Dr. Newman will write to Dr. Kelly M.D. St. Louis immediately asking for further information on this problem, and will communicate with you as and when he receives a reply.

WHR
W.H. RITCHIE.

MONS 095207



St. Louis

Dec. 11/51

(Airmail)

Mr. W. E. Hamer, Ruabon
Mr. W. H. Ritchie, Ruabon
Dr. H. R. Newman, Ruabon
Mr. S. M. Kulifay, Krummrich
Dr. D. S. Weddell, St. Louis
Mr. F. T. Marshall, St. Louis

Mr. P. J. C. Haywood

Newport (Airmail)

AROCLORS: TOXICITY

Since writing to you on December 3rd I have come across a letter of mine to Mr. W. M. Cooper, London, June 24/48, (copies to W.D.S., W.H.G., and others), calling attention to an article in the J.T. Baker Company's "Chemist Analyst", Vol. 26, No. 2, page 33, September 1947.

I attach a copy of this article, and I think you will agree that the warning relates only to really bad exposure, not such as should occur in ordinary analytical work.

On Oct. 27/47 Mr. Barbre of the Krummrich plant sent a copy of this Journal to Dr. Jenkins at Anniston for comment. Dr. Jenkins did not make any comments at the time, but the following extract from Mr. Barbre's letter is interesting:

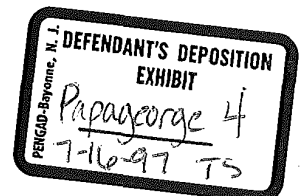
"During the 11 years of production here only one man evidenced dermatitis. He had also shown similar symptoms in several other departments. When making Aroclor #1270 which is flaked, a noticeable amount of fine fume solidifies in the air. If men are exposed to it during hot humid weather, the skin is irritated, but we have not had any difficulty in curing cases of dermatitis from it".

E. Mather

tm



MONS 095205



The Chemist Analyst, Vol.36, No.2, page 33,
J.T.Baker Chemical Co., Phillipsburg, N.J.,
September 1947

On the Toxicity of the "Arochlors" (sic)

Robert M. Brown, Chief,
Industrial Hygiene Section, Division of Health,
Dept. of Public Welfare, City of St.Louis, Mo.

A recently published article (Maglio, M.Martin, Chemist Analyst, 35 94 (1946)), has recommended the substitution of one of the "Arochlors" as the melting-point bath liquid in preference to the customary sulphuric acid. As stated in that article "Arochlors" are a group of chlorinated diphenyls produced by the Monsanto Chemical Company.

There is need therefore to give warning. For the toxicity of these compounds has been repeatedly demonstrated, both from the standpoint of their absorption from the inspired air as well as from their effects in producing a serious and disfiguring dermatitis when allowed to remain in contact with the skin. Since these effects have been repeatedly observed, industrial hygienists have taken care to see that the proper controls have been established wherever these products are used. For example, the maximum allowable concentration of chlorinated diphenyl for an 8-hour working day is 1 milligram per cubic meter of air.

It is probable that nothing like an uncontrolled industrial exposure will occur in the laboratory. However, whether an individual is subjected to a possible acute exposure to chlorinated diphenyl, and its serious consequences, will depend upon the size of the melting-point bath, the caution with which it is used, and the temperature to which it may be heated. Likewise, with careless handling of the material and the resulting contamination of the skin, clothing, laboratory towels, work table surfaces, etc. the way is left open for the producing of dermatitis. Scrupulous cleanliness must be insisted upon wherever this material is handled.

The foregoing remarks have been prompted by the belief that in recommending the use of a material with which is associated a potential hazard from the health standpoint, it is very important that the possible consequences be presented together with recommendations for correct handling.

MONS 095206

St. Louis

(Airmail)

December 17/51

Mr. W.E. Hamer, Ruabon
Mr. W.H. Ritchie, Ruabon
Dr. H.R. Newman, Ruabon
Mr. S.M. Kulifay, Krumm-ic
Dr. D.S. Weddell, St. Louis
Mr. F.T. Marshall, St. Louis

Mr. P. J. C. Haywood

HR

Newport (Airmail)

F → AROCLORS: TOXICITY

Since writing my note of Dec. 11/51 I have chanced to learn that Anniston people had quite serious skin troubles: boils, blackheads and the like, among workers in Aroclors, especially 1269, around 1933.

A little browsing into the literature reveals quite a history of skin troubles and liver troubles (including some fatal cases) attributed to heavy exposure to chlorinated diphenyls.

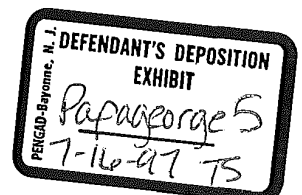
The chlorinated diphenyls are stated to be worse than chlornaphthalenes, and to be more harmful the more chlorine they contain. I still think, however, that the exposure in ordinary analytical work should not cause any trouble.

E. Mather

tm



MONS 095204



C O P Y

Dr. H.R. Newman.

February 12th, 1954.

Newport, England.

We do not know what the maximum allowable concentration of Aroclor is. One milligram per cubic meter has been set up. We have run animals for about 60 days at 7 times this and found some liver damage. We are now running this at a lower level.

We have never found any liver trouble in any of the workers in our plant, but we watch the control of the fumes in our customers' plants and always recommend exhaust ventilation. I am sure you realize that 1 mg per cubic meter is recommended for an 8-hour day for indefinite periods of time. In painting a room we have found 1 - 2 mg for a day or so, but after that the level drops down to nothing.

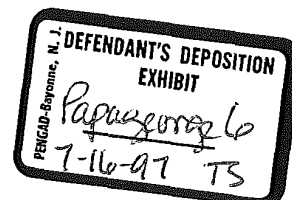
independent
What we were really worrying about was the possibility that a man would develop hepatitis on an idiopathic, viral, or serum basis and on questioning would recall that he had painted a room with Aroclor paint and state that he had smelled it very strongly. I am afraid then we might be convicted by association even though we were sure one could not get a level high enough to cause trouble. We have, however, been concerned with the level of Aroclor during spray painting, but I think that level can only be determined by actual measurements.

Please do not worry about asking me these questions because we certainly want you to have the entire picture about Aroclor toxicity. As soon as I get a report on the work at Kettering, I will let you know.

R. Emmet Kelly, M.D.

REK/MFL.

MONS 095193



chloronaphthalene per cubic meter of air. Drinker and others showed that concentrations of this order damaged the livers of rats, on long exposure.^{100,101}

When hot, these compounds should be handled in closed systems or with very effective ventilation. In addition to serious systemic effects, these waxes are bad dermatitis producers, causing a skin condition known as chloracne. Occasionally such dermatitis results from handling wires whose insulation is impregnated with this wax, but it is more prevalent where the wax is handled in a molten state.

The concentrations of chloronaphthalene fumes found in various processes in Massachusetts are listed in Table 31.

TABLE 31
MALOWAX FUME CONCENTRATIONS

Operation	Type of Wax	Number of Studies	Concentration (mg/m ³)	
			Max	Avg
Condenser impregnating	Trichloronaphthalene	7	20	7.0
Condenser sealing	Hexachloronaphthalene	2	2	1.4
Condenser soldering	Trichloronaphthalene	3	2	1.0
Wire impregnating	Hexachloronaphthalene	2	11.1	3.0

Other fatal cases of liver atrophy attributed to chlorinated naphthalene fumes arising from condenser-sealing processes and coating of electric cables have been reported in this country.¹⁰² One death and several cases of dermatitis were caused in England by chlorinated naphthalene used for protecting metals in chromium plating, according to Collier.¹⁰³ An outbreak of dermatitis occurred in Missouri from the employment of marking crayon, containing chlorinated naphthalene binder, on hot metal castings.¹⁰⁴

4. Chlorinated Diphenyls, C₁₂H₇Cl₂ (12.2)

Harmful effects: Irritation; liver damage.

Degree: Can be serious.

Maximum allowable concentration: 0.5-1.0 mg/m³.

Evaluation: Air analysis.

The chlorodiphenyls, known as Aroclor or Dykannol, are used as heat-transfer media and for the impregnation of dielectrics, wire insulation, etc. Animal experiments have indicated that some of these

ORGANIC CHLORINE compounds, liver damage, consisting of the tri- and tetra- chlorinated compounds, Drinker's work in Massachusetts.

Condenser impregnating
Condenser sealing
Oil mixing
Regulator filling

In none of the chlorodiphenyls of 10 mg per

5. Chlorinated

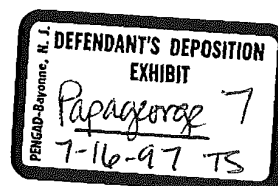
In the molten state, consisting of hexachloronaphthalene and others, by the same

6. Dichlorinated

Melting point
Harmful effects
Degree of toxicity
Maximum allowable concentration
Evaluation

DDT and other properties.

MONS 076158



compounds are relatively non-toxic, whereas others apparently cause liver damage.¹⁰⁰ According to Troom and co-workers, Aroclor 1254, consisting chiefly of pentachlorodiphenyl, is several times as toxic as the trichlorodiphenyl, Aroclor 1242.¹⁰¹ Some of the references in the literature regarding the toxicity of chlorinated diphenyl refer to Drinker's original experiments with chlorinated triphenyl.

Atmospheric concentrations of various chlorodiphenyl fumes found in Massachusetts plants are given in Table 32.

TABLE 32
AROCLOR FUME CONCENTRATIONS

Process	Chlorodiphenyl Fume Concentration (mg/m ³)	
	Max	Avg
Condenser impregnating	10.5	5.5
Condenser impregnating	5.5	4.5
Condenser soldering	0.3	0.2
Condenser soldering	0.9	0.8
Oil mixing	1.1	0.6
Regulator filling	0.2	0.1

In none of these plants was there any evidence of toxic effects from the chlorodiphenyl; but the highest concentrations found, of the order of 10 mg per cubic meter, were unheavily irritating.

5. Chlorinated Triphenyl

In the manufacture of chlorinated diphenyl, certain by-products, consisting mainly of a mixture of chlorotriphenyls, are produced. Some of these mixtures are even more powerful liver poisons than hexachloronaphthalene, according to the animal studies by Drinker and others. They have been used for similar purposes and are known by the same trade name, Aroclor, as certain of the true chlorodiphenyls.

6. Dichlorodiphenyltrichloroethane, (C₆H₄Cl)₂-CH-CCl₃ (DDT)

Melting point: 108° C.

Harmful effects: Damage to nervous system, liver.

Degree: Can be serious.

Maximum allowable concentration: (2 mg/m³).

Evaluation: 1. Air analysis.

2. Urine analysis.

DDT achieved sudden prominence by reason of its remarkable properties as an insecticide and its wide use in World War II as a

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dehousing agent and in large-area mosquito control. *p,p'*-Dichlorodiphenyltrichloroethane is the active ingredient of DDT, but the less active *ortho-para* isomer occurs as a major impurity in the technical product.

At present, DDT is probably the most widely used insecticide. In spite of the fact that it is toxic to warm-blooded animals, there have been relatively few proven cases of serious human poisoning. In the majority of deaths following ingestion of DDT solutions, the clinical picture has been characteristic of solvent poisoning.¹¹² Unless grossly misused, the hazard from DDT application is not great. Similarly the mixing of DDT dusts produces only a moderate hazard, provided a reasonable degree of dust control is maintained.

DDT is excreted in the urine as DDA (bis-*p*-chlorophenyl acetic acid). Analysis of fat for stored DDT has also been used as a measure of absorption.

7. Chlordane, $C_{12}H_8Cl_2$

(1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro-4,7-methanonindane)

Harmful effects: Damage to nervous system, liver.

Degree: Can be serious.

Maximum allowable concentration: (2 mg/m³).

Evaluation: 1. Urine analysis.

2. Air analysis.

Although the toxicity of chlordane, as measured by ingestion experiments with animals, is less than that of DDT and similar chlorinated insecticides, several human poisonings have followed its use or ingestion. Of 15 such cases reported by Conley, 5 were fatal. Ingestion was responsible for 8 of these cases, skin absorption and inhalation for the rest.¹¹³ Chlordane appears to be absorbed through the skin more readily than DDT.

8. Dieldrin, $C_{12}H_8Cl_6O$

(1,2,3,4,10,10-Hexachloro-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-indoxo-5,8-dimethanonaphthalene)

Harmful effects: Damage to central nervous system.

Degree: Can be serious.

Maximum allowable concentration: (0.25 mg/m³).

Although dieldrin is known as one of the most toxic of the chlorinated insecticides, its use in this country has not produced any notable

ORGANIC COMPOUNDS

incidence of ... South America, among sprayers ... ing symptoms ... stoma, nausea, ... tory ... of ... loss of ... case ...

These effects ... covey, ... Some abnormal ... sprayers who ... It is clear that ... require greater ... insecticide.

Other chloro ... Chapter 11.

HALO

1. Ethylene Chloride

Molecular wt ... Harmful effects ... Degree: Serious ... Maximum allow ... Evaluation: A

This water-soluble toxic solvent ... them fatal, but ... tion, others to ... sulting from ... ppm ... Go ... allied symptoms ... ethylene chloride was ... There were ... months' exposure ... of the potatoes.

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incidence of intoxication. Numerous cases have been reported in South America, however. Hayes, in discussing 63 clinical cases among spraymen in Venezuela, Ecuador, and Nigeria, lists the following symptoms: headache, blurred vision, twitching, sweating, insomnia, nausea, and general malaise.¹⁰⁰ In severe poisoning involuntary jerking of muscle groups, sometimes causing falling, involuntary loss of consciousness, and epileptic convulsions occurred. One such case terminated fatally.

These effects were apparently due to chronic intoxication and recovery, following removal from exposure, was frequently shown. Some abnormality in electroencephalograms was noted in dieldrin spraymen who were considered well clinically.

It is clear that dieldrin, and the closely related endrin and aldrin, require greater precaution in handling than is customarily used with insecticides.

Other chlorinated compounds used as insecticides are discussed in Chapter 11.

HALOGENATED ALCOHOLS, ETHERS, AND ESTERS

1. Ethylene Chlorohydrin, $\text{CH}_2\text{OHCH}_2\text{Cl}$

Molecular weight: 80.5. Boiling point: 132°C .

Harmful effects: Liver, kidney, and brain damage.

Degree: Serious, fatal.

Maximum allowable concentration: (5 ppm).

Evaluation: Air analysis.

This water-soluble liquid, chloromethyl alcohol, is among the most toxic solvents commercially available. Several poisonings, some of them fatal, have been reported. Some were attributed to skin absorption, others to inhalation. Dierker and Brown report a fatal case resulting from a 2-hour exposure to a concentration estimated at 300 ppm.¹⁰¹ Goldblatt and Chrisman report chronic effects, nausea, and allied symptoms, in a plant where the average concentration of ethylene chlorohydrin vapor was found to be 18 ppm.¹⁰² Ethylene dichloride was also present, in concentrations of the order of 60 ppm. There were two fatal cases, one acute and one chronic, following 2 months' exposure. Fatal poisoning has also resulted from the employment of ethylene chlorohydrin vapor to stimulate the sprouting of potatoes.

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DANGEROUS PROPERTIES of INDUSTRIAL MATERIALS

A Completely Revised and Enlarged Edition of
HANDBOOK OF DANGEROUS MATERIALS

edited by
N. IRVING SAX

*Consultant on Industrial Safety
Nuclear Development Corporation of America
White Plains, N. Y.*

Assisted by

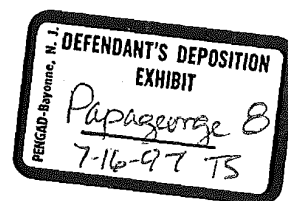
LEONARD J. GOLDWATER
*Professor of Occupational Medicine
Columbia University
New York, N. Y.*

JOSEPH J. FITZGERALD
*Harvard University
Cambridge, Massachusetts*

JOHN H. HARLEY
*Chief, Analytical Branch
Health and Safety Laboratory
U. S. Atomic Energy Commission
New York, N. Y.*

WILLIAM B. HARRIS
*Chief, Industrial Hygiene Branch
Health and Safety Laboratory
U. S. Atomic Energy Commission
New York, N. Y.*

MILTON S. DUNN
*Medical Director, Rensselaer Division
General Aniline and Film Corp.
Rensselaer, N. Y.*



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ABBREVIATIONS USED IN SECTION 10

ACGIH	American Council of Governmental and Industrial Hygienists
anh.	anhydrous
atm.	atmospheres
Autoign. Temp.	autoignition temperature
B.P.	boiling point
C.C.	closed cup
C.O.C.	Cleveland open cup
decomp.	decomposition
°C	degrees centigrade
°F	degrees Fahrenheit
Flash P.	flash point
I. C. C.	Interstate Commerce Commission
L. E. L.	lower explosive limit
MAC	maximum allowable concentration
MCA	Manufacturing Chemists' Association
M.P.	melting point
mm	millimeters
Mol. Wt.	molecular weight
O.C.	open cup
T.O.C.	Tag open cup
U.E.L.	upper explosive limit
Vap. D.	vapor density
Vap. Press.	vapor pressure

CHLORINATED DIPHENYLS

Description: Colorless mobile liquid

Constants:

B. P. 340 - 375°C

Flash P. 383°F (C.O.C.)

Density 1.44 @30°C

Toxic Hazard Rating:

Acute Local: Irritant 2

Acute Systemic: Ingestion 3; Inhalation 3

Chronic Local: Irritant 3

Chronic Systemic: Inhalation 3;

Skin Absorption 2

MAC: ACGIH (accepted): 1 milligram per cubic meter of air.

Toxicology: Like the chlorinated naphthalenes, the chlorinated diphenyls have two distinct actions on the body, namely, a skin effect and a toxic action on the liver. The lesion produced in the liver is an acute yellow atrophy. This hepato-toxic action of the chlorinated diphenyls appears to be increased if there is exposure to carbon tetrachloride at the same time. The higher the chlorine content of the diphenyl compound, the more toxic is it liable to be. Oxides of chlorinated diphenyls are more toxic than the unoxidized materials.

The skin lesion is known as chloracne, and consists of small pimples and dark pigmentation of the exposed areas, initially. Later, comedones and pustules develop. In persons who have suffered systemic intoxication the usual signs and symptoms are nausea, vomiting, loss of weight, jaundice, edema and abdominal pain. Where the liver damage has been severe, the patient may pass into coma and die.

Fire Hazard: Slight, when exposed to heat or flame (Section 6).

Disaster Control: Dangerous; when heated to decomposition, they emit highly toxic fumes.

Ventilation Control (use moderate rate): Section 2

Personnel Protection: Section 3

Personal Hygiene: Section 3

First Aid: Section 1

Storage and Handling: Section 7

Shipping Regulations: Section 11
MCA warning label.

CHLORINATED HYDROCARBONS, ALIPHATIC

Toxicology: The substitution of a chlorine (or other halogen) atom for a hydrogen greatly increases the anesthetic action of a member of the aliphatic hydrocarbons. In addition, the chlorine derivative is usually less specific in its action and may affect other tissues of the body in addition to those of the central nervous system; in many cases the chlorine derivative is quite toxic. Thus, chloroform, in addition to its narcotic qualities, may cause liver, heart, and kidney damage.

As a general rule, the unsaturated chlorine derivatives are highly narcotic but less toxic than the saturated derivatives, thus causing degenerative changes in the liver and kidneys less frequently. In the saturated group, the narcotic effect is enhanced with an increase in the number of chlorine atoms. However, there is less relationship between the number of chlorine atoms present and the toxicity of the compound.

In dealing with these chlorinated hydrocarbons, it must be remembered that a toxic action may result from repeated exposure to concentrations which are too low to produce a narcotic effect, and which, consequently, are too low to give warning of danger. Individual susceptibility is also important when poisoning by this group of solvents is being considered. Certain workmen may be seriously affected by concentrations that seem to have no effect on fellow employees in the same exposure.

Disaster Control: Dangerous; when heated to decomposition, they emit highly toxic fumes of phosgene; they can react with oxidizing materials.

Storage and Handling: Section 7

CHLORINATED HYDROCARBONS, AROMATIC

Toxicology: In most instances it is difficult to predict the toxicity of these compounds. However, in

Toxic Rating Code: 0 = None 1 = Slight 2 = Moderate 3 = High U = Unknown

truckloads or less-than-truckloads when handled by a motor vehicle not requiring transfer from one motor carrier to another. When offered for transportation by carrier by water each package must show the name or mark of the consignor and/or consignee.

(d) Each package of chemical ammunition, explosive, containing poisonous gases, solids or liquids, class A, class B or class C must also have securely attached to it labels prescribed by § 73.409 (a) (1), (a) (2), or (a) (3) of this part.

(1) Carload or truckload shipments of chemical ammunition, explosive, containing poisonous gases, solids or liquids, class A, class B, or class C offered for transportation by, for, or to the Departments of the Army, Navy, and Air Force of the United States Government are exempt from labeling requirements when shipments are loaded or unloaded by the shipper or his duly authorized agent and such shipments are accompanied by qualified personnel supplied with equipment to repair leaks or other container failure which will permit escape of contents.

(e) Each shipment of samples of explosives when offered for transportation by carriers by rail express or water must bear the label prescribed by § 73.411 of this part and each shipment of special fireworks in addition to the marking prescribed by § 73.91 (i) of this part when offered for transportation by carriers by rail express or water must bear the label prescribed by § 73.410 of this part.

(f) Each shipment of propellant explosives when offered for transportation by carriers by rail express must bear the label prescribed by § 73.412.

(g) Each package of explosives must be marked with the I.C.C. specification number as prescribed by the specification, if an I.C.C. specification container is required.

§ 73.401 **Dangerous articles.** (a) Packages containing flammable liquids, flammable solids, oxidizing materials, corrosive liquids, compressed gases, and poisons, as defined in this part must be marked, unless exempted, with the proper shipping name as shown in the commodity list (see § 72.5). For tank cars this marking must appear either on the placards or commodity cards.

(1) Every portable tank used for the transportation of any dangerous article shall be conspicuously and legibly marked on a background of sharply contrasting color with a sign or lettering on the tank with words as appropriate "CORROSIVE LIQUID," "COMPRESSED GAS," or "FLAMMABLE COMPRESSED GAS" and with the proper shipping name as shown in the commodity list (see § 72.5); the height of all required lettering shall be at least 2 inches or 1/10 the diameter of the tank, whichever is the greater; every portable tank container shall be marked with the owner's name; in addition to the markings hereinbefore required, there may be marked on any portable tank container the trademark appropriate to the commodity being transported therein: **Provided,** however, That no such marking shall be of such size and character as to render inconspicuous the required markings. No markings either required or permitted under the terms of this subparagraph shall be in lieu of any other marking or markings required by the Commission

(b) Each package of dangerous articles must show the name and address of the consignee except in carloads and truckloads or less-than-truckloads when handled by a motor vehicle not requiring transfer from one motor carrier to another.

(c) Packages containing flammable liquids in inside containers of 1 quart capacity or larger, or corrosive liquids, acids, alkaline caustic liquids, liquid oxidizing materials and poisonous liquids in inside containers regardless of capacity, unless specifically exempted or otherwise provided in this part, must be packed with filling holes up, and except for carboys not completely boxed, the outside container must be plainly marked "THIS SIDE UP" or "THIS END UP" on the cover or top to indicate the position of the inside containers. This requirement does not apply to materials in inside metal cans of the nonrefillable type with spun-in head and base and having no replaceable cap or other closing device.

(d) Each package must show the specification marking as required if a specification container is prescribed.

(e) Additional shipping information not inconsistent with Parts 71-78 may be shown on a container if so desired but no such label or marking shall be of a design, or form, or size, as may be confused with the marking required by Parts 71-78.

§ 73.402 **Labeling dangerous articles.** (a) Each package containing any dangerous article as defined by Parts 71-78 must be conspicuously labeled by the shipper as follows, except as otherwise provided:

(1) "Red label" as described in § 73.405 on containers of flammable liquids, except when exempted from the regulations by § 73.118. If flammable liquid is also a class A poison or a radioactive material poison D, the "poison gas" label or "Radioactive materials" label must also be applied to the package.

(2) "Yellow label" as described in § 73.406 on containers of flammable solids and oxidizing materials, except when exempted from the regulations by § 73.153 and § 73.183. If flammable solid or oxidizing material is also a class A poison or a radioactive material poison D, the "poison gas" label or "radioactive materials" label must also be applied to the package.

(3) "White label" as described in § 73.407 (a) (1), (2) and (3) on containers of acids, alkaline caustic liquids or corrosive liquids, except when exempted from regulations by § 73.244. If the acid, alkaline caustic liquid or corrosive liquid is also a class A poison or a radioactive material poison D, the "poison gas" label or "radioactive materials" label must also be applied to the package.

(4) "Red label" as described in § 73.408 (a) (1) on containers of flammable compressed gases, except when exempted from the regulations by § 73.302. If the flammable compressed gas is also a class A poison or a radioactive material poison D, the "poison gas" label or "radioactive materials" label must also be applied to the package.

(5) "Green label" as described in § 73.408 (a) (2) on containers of nonflammable compressed gases, except when exempted from the regulations by § 73.302. If the nonflammable compressed gas is also a class A poison or a radioactive material poison D, the "poison gas" label or "radioactive materials" label must also be applied to the package.

(6) "Poison gas" label as described in § 73.409 (a) (1) on containers of class A poisons.

(7) "Poison" label as described in § 73.409 (a) (2) on containers of class B poison liquids or solids, except when exempted from the regulations by § 73.345 and § 73.354. If the class B poison liquid or solid is also a radioactive material poison D, the "radioactive materials" label must also be applied to the package.

(8) "Radioactive Materials" label as described in § 73.414 (a) on containers of class D poisons, Group I and II except when exempted by § 73.392.

(9) "Radioactive Materials" label as described in § 73.414 (b) on containers of class D poisons, Group III, except when exempted by § 73.392.

(10) "Tear gas" label as described in § 73.409 (a) (3) on containers of poisons, class C.

(11) "Bung label" as described in § 73.119 (i) of this part on metal barrels or drums containing flammable liquids with vapor pressure exceeding 16 pounds per square inch absolute.

(12) "Empty label" as described in § 73.413 of this part must be applied to containers which have been emptied and on which the old label has not been removed, obliterated, or destroyed. It must be so placed on the container as to completely cover the old label.

(13) Labels prescribed for shipments of explosives and other dangerous articles by air between the United States, its territories and possessions, and other countries, as shown in §§ 73.403 (b), 73.406 (b), 73.407 (b), 73.408 (b), 73.409 (b), 73.410 (b), 73.411 (b), 73.412 (b) and 73.414 (c), may be used in lieu of labels otherwise prescribed and for local transportation to or from airport.

(b) Labels when applied to packages offered for transportation by rail express, rail baggage, or other forms of transportation for which a certified shipping order, bill

ading, or other shipping paper is not required, must shipper's name in printing, stamping, or writing underneath the certificate printed thereon.

(1) Labels prescribed for shipments of explosives or dangerous articles by air between the United States, territories, possessions and other countries, as shown § 73.405 (b), 73.406 (b), 73.407 (b), 73.408 (b), 73.409 (b), 73.410 (b), 73.411 (b), 73.412 (b) and 73.414 (c) are required. Such shipments must be tendered with a red certificate, in duplicate, reading as follows: (one red copy shall be retained by the original carrier):

This is to certify that the contents of this package are properly described by name and are packed and marked in proper condition for transportation according to the regulations prescribed by the Interstate Commerce Commission and the Civil Aeronautics Board. (For shipment on passenger-carrying aircraft the following must be added to certificate: This shipment is within the limitations prescribed for passenger-carrying aircraft.)

(c) Labels and marking name of contents are not required on carload or truckload quantities of dangerous articles, except class A, class C, or class D poisons, by freight, rail express, or highway, when such shipments are unloaded by the consignee or his duly authorized agent from the car or motor vehicle in which originally loaded.

(1) Carload or truckload shipments of class A, class C, or class D poisons offered for transportations for, or to the Departments of the Army, Navy, and Air Force of the United States Government are exempt from labeling requirements when shipments are loaded or unloaded by the shipper or his duly authorized agent and such shipments are accompanied by qualified personnel supplied with equipment to repair leaks or other containment failure which will permit escape of contents.

(d) Except on class A, class C, or class D poisons, labels are not required on less-than-truckload shipments motor vehicle by public highway when the articles are readily identifiable by reason of type of container when the container is plainly marked to indicate its contents and;

(1) When the shipment is transported from origin to destination without transfer between vehicles and;

(2) When the shipper or its employees are in direct control or perform the loading, transporting and unloading.

(e) When it is known that subsequent shipments of these packages may be made by consignees in less-than-carload or less-than-truckload quantities, or in carload or truckload quantities to a point where they may be handled by other than the original consignee, the original shipper should attach labels to the packages as would be required for less-than-carload or less-than-truckload shipments.

§ 73.403 Labels for mixed packing. (a) Use red label only when red and other labels are prescribed except when poison gas label or radioactive materials label are prescribed then both the red label and the poison gas label or red label and radioactive materials label must be used.

(b) Use White acid (alkaline caustic liquid or corrosive liquid) label only when white acid (alkaline caustic liquid or corrosive liquid) and yellow or poison labels are prescribed or poison labels (class B) are prescribed, except when poison gas label or radioactive materials label are prescribed then both the white acid label and the poison gas label or white acid and radioactive materials label must be used.

(c) Use yellow label only when yellow and poison labels are prescribed except when poison gas label or radioactive materials label are prescribed then both the yellow label and the poison gas label or the yellow label and the radioactive materials label must be used.

§ 73.404 Labels. (a) Shippers must furnish and attach the labels prescribed for their packages. Labels should be applied to that part of the package bearing consignee's name and address.

(b) Labels must not be applied to packages containing articles which are not subject to Parts 71-78 or are exempted therefrom.

(c) Shippers must not use labels which by their size, shape, and color, may readily be confused with the standard caution labels prescribed in this part.

(d) Labels must conform to standards as to size, printing, and color, and samples will be furnished, on request, by the Bureau of Explosives.

(e) A combination diamond-shaped label-tag of proper size and color, bearing on one side the shipping information and on the reverse side the wording prescribed in this part, will be permitted.

(f) As certification of compliance with regulations is also required by other Government agencies, and to avoid multiplicity of certifications, there may be added to the certificate on labels "and the Commandant of the Coast Guard," or "and the Civil Air Regulations," or "and the Post Office Department," as is necessary.

(g) The carrier's name and stationery form number, or the shipper's name and address, may be printed on the labels, in type not larger than 10 point, if placed within the black-line border and in the upper or lower corner of the diamond.

(h) Labels remaining on hand and which were authorized by regulations in effect on December 31, 1950, may be used until present stocks are exhausted.

§ 73.405 Flammable liquids label. (a) Labels for flammable liquids must be of diamond shape, bright red in color, and with each side 4 inches long. Printing must be in black letters inside of a black-line border measuring 3½ inches on each side and as shown in this section.

RED LABEL FOR FLAMMABLE LIQUIDS

(Reduced size)

(Black printing on red)



(b) Red label for flammable liquids for shipment by air.

(Reduced size)

Red and black with (black printing on red)



(b) Yellow label for flammable solids for shipment by air.

(Reduced size)

Yellow and black with (black printing on yellow)



§ 73.406 Flammable solids and oxidizing materials label. (a) Labels for flammable solids and oxidizing materials must be of diamond shape, bright yellow in color, and with each side 4 inches long. Printing must be in black letters inside of a black-line border measuring 3½ inches on each side and as shown in this section.

YELLOW LABEL FOR FLAMMABLE SOLIDS AND OXIDIZING MATERIALS

(Reduced size)

(Black printing on yellow)



§ 73.407 Acids, corrosive liquids, and alkaline caustic liquids labels. (a) Labels for corrosive liquids, acids and alkaline caustic liquids must be of diamond shape, white in color, and with each side 4 inches long. Printing must be in black letters inside of a black-line border measuring 3½ inches on each side and as shown in this section.

(1) WHITE LABEL FOR ACIDS:

(Reduced size)

(Black printing on white)



(2) WHITE LABEL FOR CORROSIVE LIQUIDS:

(Reduced size)

(Black printing on white)



(b) Labels for shipments of acids, corrosive liquids, and alkaline caustic liquids by air must be as shown in the following:

(1) White label for acids for shipment by air.

(Reduced size)

White and black with (black printing on white)



(3) WHITE LABEL FOR ALKALINE CAUSTIC LIQUIDS:

(Reduced size)

(Black printing on white)



(2) White label for corrosive liquids for shipment by air.

(Reduced size)

White and black with (black printing on white)



(3) White label for alkaline caustic liquids for shipment by air.

(Reduced size)

White and black with (black printing on white)



(2) GREEN LABEL FOR NONFLAMMABLE GASES:

(Reduced size)

(Black printing on green)

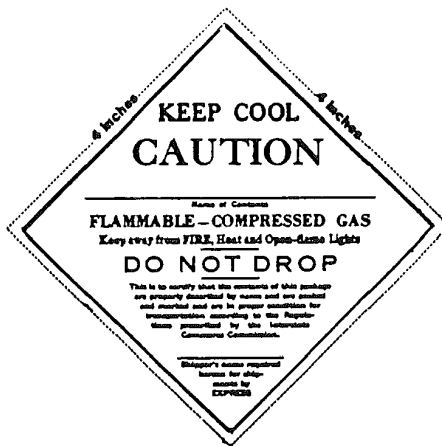


§ 73.408 Compressed gas labels. (a) Labels for compressed gases must be of diamond shape, bright red in color for flammable gases and bright green for nonflammable gases, and with each side 4 inches long. Printing must be in black letters inside of a black-line border measuring $3\frac{1}{2}$ inches on each side and as shown in this section.

(1) RED LABEL FOR FLAMMABLE GASES.

(Reduced size)

(Black printing on red)



(b) Red label for flammable gases for shipment by air.

(Reduced size)

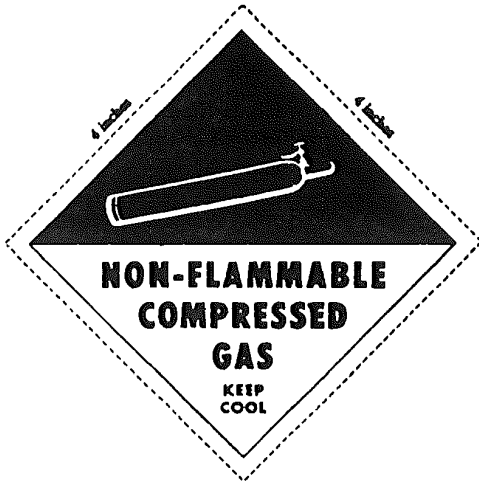
Red and black with (black printing on red)



(1) Green label for nonflammable gases for shipment by air.

(Reduced size)

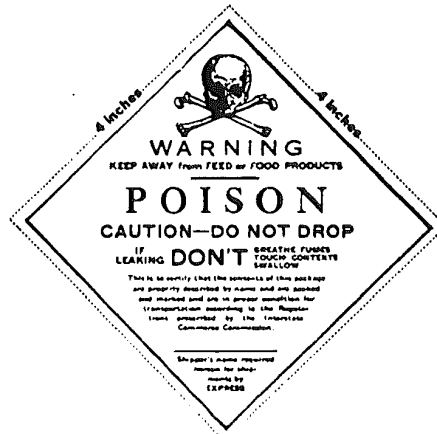
Green and black with (black printing on green)



(2) POISON LABEL.

(Reduced size)

(Red printing on white)

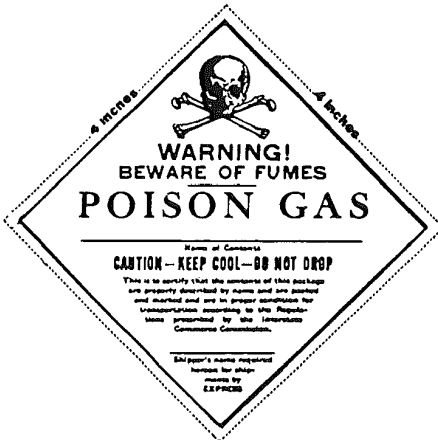


§ 73.409 Poisonous articles and tear gas labels. (a) Labels for poisonous articles and tear gases must be of diamond shape, white in color, and with each side 4 inches long. Printing must be in red letters inside of a red-line border measuring $3\frac{1}{8}$ inches on each side and as shown in this section.

(1) POISON GAS LABEL.

(Reduced size)

(Red printing on white)



(3) TEAR GAS LABEL.

(Reduced size)

(Red printing on white)



(b) Labels for shipments of poisonous articles and tear gases by air must be shown in the following:

- (1) Label for poison gas for shipment by air.

(Reduced size)

White and red with (red printing on white)



- (2) Label for poisons for shipment by air.

(Reduced size)

White and red with (red printing on white)



- (3) Label for tear gas for shipment by air.

(Reduced size)

White and red with (red printing on white)



§ 73.410 Special fireworks label. (a) Labels for special fireworks must be square measuring 4 inches on each side and bright red in color. Printing must be in black letters inside of a black-line border measuring 3 3/4 inches on each side as shown in this section.

RED LABEL FOR SPECIAL FIREWORKS

(Reduced size)

(Black printing on red)



(b) Explosives label for shipment of Special fireworks by air.

(Reduced size)

(Black printing on red)



(b) Explosives label for shipment of samples of explosives by air.

(Reduced size)

(Black printing on red)

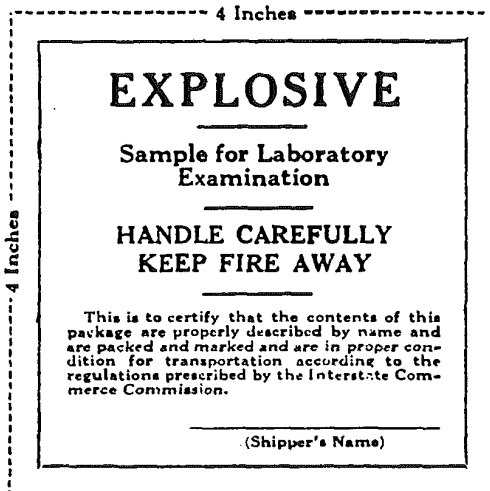


§ 73.411 Explosives samples for laboratory examination label. (a) Labels for samples of explosives for laboratory examination must be square measuring 4 inches on each side and bright red in color. Printing must be in black letters inside of a black-line border measuring $\frac{3}{4}$ inches on each side and as shown in this section.

RED LABEL FOR SAMPLE OF EXPLOSIVES

(Reduced size)

(Black printing on red)

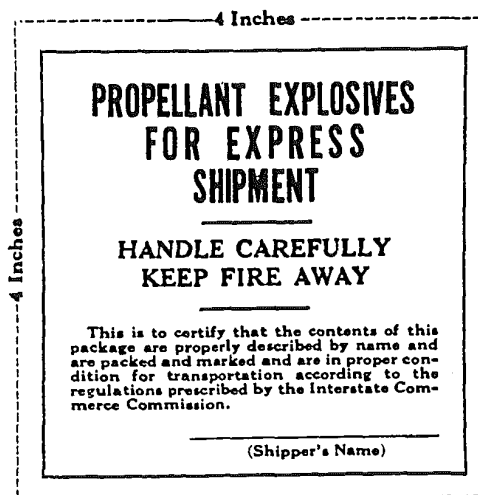


§ 73.412 Propellant explosives label for express shipment. (a) Label for propellant explosives must be square measuring 4 inches on each side and bright red in color. Printing must be in black letters inside of a black-line border measuring $\frac{3}{4}$ inches on each side and as shown in this section.

(1) RED LABEL FOR PROPELLANT EXPLOSIVE FOR EXPRESS SHIPMENT

(Reduced size)

(Black printing on red)



(b) Explosives label for shipment of Propellant explosives by air.

(Reduced size)

(Black printing on red)

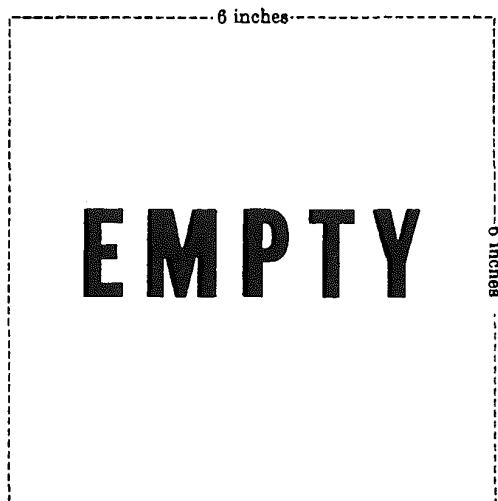


§ 73.413 Empty container label. (a) Labels for empty containers must be not less than 6 inches on each side, white in color, and printed in letters not less than 1 inch high in black ink and as shown in this section.

WHITE LABEL FOR EMPTY CONTAINERS

(Reduced size)

(Black printing on white)



§ 73.414 Radioactive materials labels. (a) Labels for radio-active materials (class D poisons) Group I and Group II must be of diamond shape, white in color, and with each side 4 inches long. Printing must be in red letters inside of a red-line border measuring $3\frac{1}{2}$ inches on each side, as shown in this section.

LABEL FOR RADIOACTIVE MATERIALS GROUP I OR II

(Reduced size)

(Red printing on white)



NOTE. This label must be duly executed by the shipper and the number of radiation units must be shown. For purposes of these regulations 1 unit equals 1 miliroentgen per hour at 1 meter for hard gamma radiation or the amount of radiation which has the same effect on film as 1 mrhm or hard gamma rays of radium filtered by $\frac{1}{2}$ inch of lead.

(b) Labels for radioactive materials (class D poisons) Group III must be of diamond shape, white in color, and with each side 4 inches long. Printing must be in blue letters inside of a blue-line border measuring $3\frac{1}{2}$ inches on each side, and as shown in this section.

LABEL FOR RADIOACTIVE MATERIALS GROUP III

(Reduced size)

(Blue printing on white)



(c) Label for Radioactive Materials Groups I and II for shipment by air.

(Reduced size)

Red and white with (red printing on white)



(1) Label for Radioactive Materials Group III for shipment by air.

(Reduced size)

Blue and white with (blue printing on white)



SUPART I — SHIPPING INSTRUCTIONS

§ 73.425 "Order-Notify," "C. O. D.," and "Stop-off" shipments. (a) Except on through bills of lading to a foreign country, shipments of explosives, class A and blasting caps in any quantity must not be offered for transportation by carriers by rail freight or rail express when consigned "to order notify" or "C.O.D." Shippers must not consign these shipments to themselves at points where they have not a resident representative.

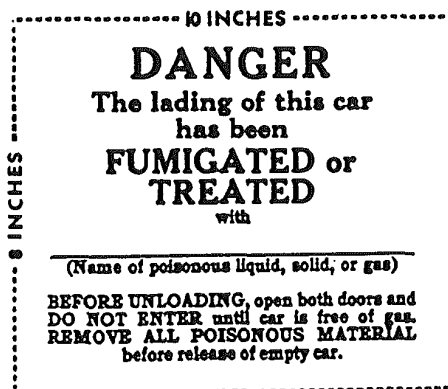
(b) Explosives, class A must not be offered for transportation by carriers by rail freight or rail express subject to "stop-off" privileges en route for partial loading or unloading.

§ 73.426 Cars containing lading which has been fumigated or treated with flammable liquids, flammable gases, poisonous liquids or solids, or poisonous gases. (a) Delivery to carrier of cars containing lading fumigated or treated with flammable liquid or flammable gas is prohibited until 48 hours have elapsed after such fumigation or treatment, or until car has been ventilated so as to remove danger of fire or explosion due to the presence of flammable vapors.

(b) Cars containing lading which has been fumigated or treated with poisonous liquid, solid, or gas, such as carbolic acid, liquid or solid, chlorpicrin, hydrocyanic acid, methyl bromide, etc., must be placarded on each door or near thereto with placard reading as follows (for cleaning cars, see § 74.566):

(Reduced size)

(Red lettering on white cardboard)



§ 73.427 Shipping order and bill of lading description. (a) The shipper when offering for transportation by carriers by rail freight, rail express, highway, or water any class A, class B, or class C explosive, flammable liquid, flammable solid, oxidizing material, corrosive liquid, compressed gas, or poison, as defined by this part, must describe such article in the shipping order, bill of lading or other shipping paper by the shipping name used in § 72.5 (see commodity list) and may add a further description not inconsistent therewith. Abbreviations must not be used. For shipments of blasting caps and/or electric blasting caps the shipper must, in addition, show the number of caps in the shipment.

NOTE 1: In commodity list (§72.5) shipping names are shown in roman, not italics:

§ 73.428 Label or placard notation. (a) The shipping order, bill of lading or other shipping paper must also show thereon in connection with the entry of the article as prescribed in § 73.427 of this part, the color or kind of label applied, and for cars containing such articles

- "B" blasting powder. See Explosives, low.
 Beeswax, yellow. See Beeswax.
 1,2-Benzendiols. See Pyrocatechol.
 1,3-Benzendiols. See Resorcinol.
 Benzene carbonyl chloride. See Benzoyl chloride.
 Benzene diazoanilide. See beta-Diazoamidobenzol.
 Benzene diazonium chloride. See Diazobenzene chloride.
 Benzene diazonium chromate. See Diazobenzol chromate.
 Benzene diazonium nitrate. See Diazobenzene nitrate.
 1,3-Benzene dicarbonitrile. See ortho-Dicyanobenzene.
 Benzene dicarboxylic acid. See Phthalic acid.
 1,4-Benzenediols. See p-Hydroquinone.
 Benzene-1,3-diphenyl. See m-Terphenyl.
 Benzene-1,4-diphenyl. See p-Terphenyl.
 1,2,4,5-Benzene tetracarboxylic acid. See Pyromellitic acid.
 Benzene tetrachloride. See 1,2,4,5-Tetrachlorobenzene.
 1,2,3-Benzotriol. See Pyrogallol.
 Benzidine base. See Benzidine.
 Benzoate of soda. See Sodium benzoate.
 Benzoflex. See Ethylene glycol dibenzoate.
 Benzohydrol. See Benzhydrol.
 Benzoic acid anhydride. See Benzoic anhydride.
 Benzoic acid α -methyl benzyl ether. See α -Methyl benzyl benzoic acid.
 Benzoic aldehyde. See Benzaldehyde.
 Benzoic ether. See Ethyl benzoate.
 Benzol. See Benzene.
 160° Benzol. See Naphtha (coal-tar).
 1,2-Benzopyrone. See Coumarin.
 Benzosulfimide. See Saccharin.
 trans-beta-Benzoyl acrylic acid. See beta-Benzoyl acrylic acid.
 Benzoyl hydroperoxide. See Perbenzoic acid.
 Benzylbenzene. See Diphenylmethane.
 Benzyl carbinol. See Phenethyl alcohol.
 Benzyl chlorocarbonate. See Benzyl chloroformate.
 Benzyl dichloride. See Benzal chloride.
 Benzyl isoamyl ether. See Amyl benzyl ether.
 Berlin green. See Ferric ferricyanide.
 Betel. See Areca nut.
 cis-Bicyclo(2,2,1)-5-heptene-2,3-dicarboxylic acid dimethyl ester. See Dimethyl carbate.
 Biformyl. See Glyoxal.
 Bimethyl. See Ethane.
 Biphenyl. See Diphenyl.
 p-Biphenyl amine. See p-Aminodiphenyl.
 o-Biphenylene methane. See Fluorene.
 1-(4-Biphenyloxy)-2-propanol. See Propylene glycol-4-biphenyl ether.
 1,3-Bis(2-benzothiazolyl mercapto methyl) urea. See Di-(2-benzothiazyl-thiomethyl)-urea.
 2,2-Bis-(p-chlorophenyl)-1,1-di-chloroethane. See DDD.
 Bis-dimethylarsenic sulfide. See Cacodyl sulfide.
 Bis-dimethylthiocarbamyl sulfide. See Tetramethylthiuram mono-sulfide.
 2,2-Bis-(p-fluorophenyl)-1,1,1-trichloroethane. See DDDT.
 Bish. See Aconitum ferox.
 3,3-Bis(p-hydroxyphenyl)-phthalide. See Phenolphthalein.
 2,2-Bis-(p-methoxyphenyl)-1,1,1-trichloroethane. See Methoxychlor.
 Bis- α -methyl benzyl ether. See Methyl benzyl ether.
 Bismuth glance. See Bismuth trisulfide.
 m-Bismuthic acid. See Bismuth pentoxide.
 Bismuthine. See Hydrogen bismuthide.
 Bismuthnite. See Bismuth trisulfide.
 Bismuth oxycarbonate. See Bismuth carbonate, basic.
 Bismutospherite. See Bismuth carbonate, basic.
 Bis(trifluoromethyl) benzene. See Xylene hexafluoride.
 Bitter apple. See Codocynth.
 Bitter cucumber. See Codocynth.
 Bitter wood tree. See Quassia.
 Bitumen. See Asphalt.
 Black blasting powder. See Explosives, low.
 Black lead. See Graphite.
 Black precipitate. See Mercurous nitrate, ammoniated.
 Blasting oil. See Nitroglycerin.
 Blistering beetles. See Cantharides.
 Blistering flies. See Cantharides.
 Blue stone. See Copper sulfate.
 Blue vitriol. See Copper sulfate.
 Bone ash. See Calcium phosphate, tribasic.
 Boracic acid. See Boric acid.
 Boric acetic anhydride. See Boron acetate.
 o-Boric acid. See Boric acid.
 Borneo camphor. See d-Borneol.
 Borneol thiocanoacetate. See Bornyl thiocanoacetate.
 Borobutane. See Dihydrotriborane; Tetra-borane.
 Boroethane. See Diborane.
 Boron bromide. See Boron tribromide.
 Boron chloride. See Boron trichloride.
 Boron ethyl. See Boron triethyl.
 Boron fluoride. See Boron trifluoride.
 Boron methyl. See Boron trimethyl.
 Bottle gas. See Liquefied hydrocarbon gas.
 Brass powder. See Brass scrapings.
 Brazil wax. See Carnauba wax.
 Breithauptite. See Nickel antimonide.
 Brimstone. See Sulfur.
 British anti-Lewisite. See 2,3-Dimercapto-1-propanol.
 Bromochloromethane. See Chlorobromomethane.
 Bromellete. See Beryllium oxide.
 Bromic ether. See Ethyl bromide.
 Bromine analog of DDT. See 1-Trichloro-2,2-bis(p-bromophenyl) ethane.
 Bromine cyanide. See Cyanogen bromide.
 o-Bromoaniline. See Bromoaniline.
 Bromoazide. See Bromine azide.
 1-Bromobutane. See Butyl bromide.
 1-Bromo-2-chloroethane. See Ethylene chlorobromide.
 Bromochloromethane. See Methylene chlorobromide.
 ar-Bromo cumene. See Bromoisopropyl benzene.
 Bromoethane. See Ethyl bromide.
 Bromoethene. See Vinyl bromide.
 Bromoethylene. See Vinyl bromide.
 Bromoethyne. See Bromoacetylene.
 Bromomethane. See Methyl bromide.
 o-Bromo-2-phenylacetone. See Bromobenzyl cyanide.
 1-Bromopropane. See Propyl bromide.
 Bromotoluene. See Benzyl bromide.
 Brunswick green. See Copper oxychloride.
 Bunsenite. See Nickel monoxide.
 Burnt lime. See Calcium oxide.
 Butadiene. See Diacetylene.
 Butadiyne. See Diacetylene.
 Butanal. See Butyraldehyde.
 Butanal oxime. See Butyraldoxime.
 n-Butane. See Butane.
 1,4-Butane dicarboxylic acid. See Adipic acid.
 Butanedinitrile. See Succinonitrile.
 Butanedioic acid. See Succinic acid.
 Butanedioic anhydride. See Succinic anhydride.
 Butanediol. See 1,4-Butanediol.
 1,3-Butanediol. See 1,3-Butylene glycol.

MONSANTO CHEMICAL COMPANY

2/2. Make 3 copies.

701 JAMES STREET
SYRACUSE 8, NEW YORK

January 30, 1959

Mr. D. A. Berlebach, Purchasing Agent
Reynolds Metals, Inc.
Muskegon, Michigan

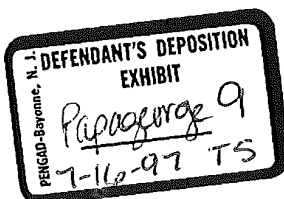
Dear Daniel:

Confirming our conversation 1/29, we will plan to ship your tank car Aroclor 1248 so that it will arrive your plant between February 13 and 18. The car will be "trip leased" to you so that you will be able to handle unloading the car etc. as conveniently as possible without having demurrage occur.

Just as soon as the car moves forward from our plant we will give you shipping instructions. We will use car OATX 32454, which is a top unloading car having an outlet of two-inches, and a one-inch steam coil inlet - both of standard pipe threads. I am sure that you will be interested in the attached information which covers the handling and unloading procedures recommended for Aroclor 1248.

Our people feel that in cleaning the filters and in encountering hot Aroclor fumes your workmen should wear an approved organic vapor cartridge respirator, such as supplied by Mine Safety Appliances Company under their catalog numbers CR-44158 bearing approval by US Bureau of Mines 201. An alternate mask would be the type tied into air line to feed air into face piece such as found in Mine Safety Appliance's bulletin CS-27. Mine Safety's main office is located at 201 North Broadway Avenue, Pittsburgh, Pa.

An additional precaution would be to carry on this filter cleaning operation with an adequate hooded vent system to protect other employees in the area. I am sure that your people will be interested in the attached information covering dermatological and toxicological characteristics of handling



**DEPOSITION
EXHIBIT**

11 Jacks
6-18-67

PROTECTED MATERIAL-Reynolds v Aetna NY

RLD-0770380

WATER_PCB-SD0000064120

Physical Properties
of
The AROCLORS

AROCLOR # 1242

AROCLOR # 1248

AROCLOR # 1254

AROCLOR # 1262

AROCLOR # 1269

AROCLOR # 4465

AROCLOR # 2565



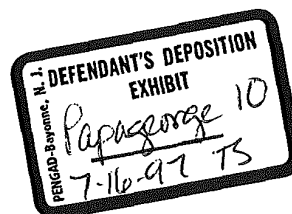
Manufactured by

Monsanto Chemical Company
St. Louis, U.S.A.

New York—Boston—Chicago—San Francisco
Cleveland—Birmingham—Montreal—London

Attachment 3-4

MONS 081237



The Aroclors

THE Aroclors have won a prominent place in the field of synthetics with unique properties to fill requirements not met quite perfectly by materials heretofore available. They have found wide usefulness in fields where their properties are of especial value.

Following is a description of the properties of seven Aroclors, each of which is representative of a series. There are other Aroclors with slightly different characteristics in each of these series.

A study of this brief description will suggest means of employing the Aroclor in perfecting still other products, development of which has been delayed by the lack of a material that exactly fulfills particular requirements.

A Description of the Aroclors

The Aroclors vary from water-white mobile oils and pale yellow viscous oils to light amber resins and opaque crystalline solids. For each of these light-colored Aroclors there is a corresponding gray or brown-black grade.

The Aroclors are produced exclusively by Monsanto Chemical Company.

Non-Flammability

The viscous Aroclor oils and the resins do not support combustion when heated alone even at their boiling points—temperatures above 350°C. Most of the Aroclors flux readily with resinous and pitch-like materials to give a product having a decreased fire hazard. When incorporated in nitrocellulose films the Aroclors retard the rate of burning.

MONS 081238

Electrical Properties

The Aroclors have extremely interesting electrical characteristics; high dielectric constant, resistivity and dielectric strength, and low power factor.

Solubility

The Aroclor oils and resins are easily soluble in most of the common organic solvents and drying oils. The hard crystalline materials are in general less soluble than the Aroclor oils or resins. All Aroclors are insoluble in water. For more complete information see the attached table. Compatibility data on Aroclors in nitrocellulose lacquers will be sent on request.

Adhesiveness

The Aroclor resins adhere strongly to smooth surfaces — to glass and metal or to smooth varnished or lacquered surfaces.

The softer Aroclors are suggested for difficult adhesive problems where a flexible non-drying waterproof material is necessary.

The Aroclor adhesives are thermoplastic; are readily applied hot without solvent; do not require high temperatures for easy application, and are set immediately upon cooling.

Thermoplasticity

The Aroclors are permanently thermoplastic. They apparently undergo no condensation or hardening upon repeated melting and cooling. The clear Aroclor resins are now being produced with softening points up to 110°C. The opaque crystalline solids are produced with initial melting points up to approximately 180°C.

Non-Drying Properties

The Aroclors are non-drying, and when they are exposed to the air, even in thin films, no noticeable oxidation or hardening takes place. However, when used as ingredients of lacquers, they do not retard the rate of drying of the lacquer films. Quick drying varnishes and paints may be made with Aroclor resins.

Vaporization Loss

The Aroclors have low vaporization losses as shown in the data in the table of physical properties.

MONS 081239

Table of Physical Properties of the Aroclors

	Aroclor 1240	Aroclor 1248	Aroclor 1254	Aroclor 1263	Aroclor 1269	Aroclor 1445	Aroclor 1563
Description (at room temperature)	Practically Water-White Mobile Oil	Practically Water-White Mobile Oil	Pale Yellow Viscous Oil	Light Yellow Soft Sticky Clear Resin	Green Colored Opaque Hard Crystalline Solid	Pale Amber Transparent Resin	Brown Black Opaque Resin
Color (1" depth of Aroclor) — Lombar yellow No. 810	0.1 to 0.5	0.1 to 0.5	0.5 to 1.0	0.5 to 1.5		4.1 to 6.4	
Pour Point °C. (A. S. T. M. Method)	-17.7 to -80.7	-9	0.0 to 10.0	24.0 to 38.0		60 to 64	68 to 78
Softening Point °C. (A. S. T. M.)							
Initial Mold Point in Freezing Curve (°C.)					330 to 345	Same as at Room Temperature	Same as at Room Temperature
Condition at 0°C.	Vacuum Liquid	Vacuum Liquid	Soft Sticky Resin	Hard Brittle Resin	Same as at Room Temperature	Same as at Room Temperature	Same as at Room Temperature
Distilling Range (°C.; A. S. T. M. Method)	311 to 345	330 to 360	345 to 381	373 to 404	Too High for A. S. T. M. Method; Can Be Distilled at Atmospheric Pressure	Too High for A. S. T. M. Method; Requires Vacuum for Distillation	Too High for A. S. T. M. Method; Requires Vacuum for Distillation
Specific Gravity At 35°C/35°C.	1.376 to 1.395	1.445 to 1.465	1.643 to 1.660	1.640 to 1.653	1.870 to 1.876	1.718 to 1.733	1.733 to 1.740
Per Cent Increase in Volume Upon Heating from 30°C. to temperature specified	8.71	24° to 45°C.—9.85% 35° to 50°C.—18.65%	8.41	4.15		2.41	2.83
Approximate Average coefficient of Expansion over range specified (cc./cc./°C.)	0.00078	0.00078	0.00061	0.00040		0.00011	0.00035
Pounds per Gallon at 30°C. (Average)	11.64	13.04	13.26	13.71	10.60	14.28	14.41
Decimal Part of Gallon Boiled by One Pound	0.0009	0.0030	0.0070	0.0720	0.61	0.8700	0.0693
Viscosity (Seconds Saybolt) at 810°F.	34.0 to 34.6	34.0 to 37.0	44.0 to 47.7	90.0 to 103.0	Solid	Too Viscous to Determine with Saybolt Apparatus	Too Viscous to Determine with Saybolt Apparatus
Viscosity (Seconds Saybolt) at 100°F.	0.11 to 0.23	0.06 to 0.10	0.06 to 0.09	None	Solid	None	None
Flash Point °C. (Cleveland Open Cup)	176 to 180	196	None	None	None	None	None
Fire Point °C. (Cleveland Open Cup)	334 to None at Boiling Point of Liquid	None	None	None	None	None	None
Refractive Index for D-Line at 30°C.	1.487 to 1.489	1.630 to 1.431	1.6407 to 1.6410	1.6401 to 1.6417		1.644 to 1.647	
Maximum Anomaly (Milligrams K(OH) per Gram)	0.01	0.01	0.01	0.02		0.02	1.20
Per Cent Loss on Heating (A. S. T. M.)	3.04 to 3.94	3.0 to 4.0	1.04 to 1.20	0.48 to 0.54	0.10 to 0.20	0.13 to 0.20	0.21 to 0.24

Toxicity

Experimental work in animals shows that prolonged exposure to Aroclor vapors evolved at high temperatures or by repeated oral ingestion will lead to systemic toxic effects.

Repeated bodily contact with the liquid Aroclors may lead to an acne-form skin eruption.

Suitable draft ventilation to control the vapors evolved at elevated temperatures, as well as protection by suitable garments from extensive bodily contact with the liquid Aroclors, should prevent any untoward effect.

Odor and Taste

The solid Aroclor resins are almost without odor and taste at ordinary temperatures.

Stability

The Aroclors are remarkably resistant to the action of either hydrolyzing agents or high temperature. They are not affected by boiling with sodium hydroxide solution. Because of their stability to heat, the Aroclors are useful heat-transfer media. Aroclor 1254 and particularly the less viscous Aroclor 1248 are recommended for this purpose because they may be heated at temperature up to 325°C. (617°F.) in a closed system for long periods without appreciable decomposition and are at the same time non-flammable.

Action on Metals

The Aroclors are non-corrosive. Mild steel exposed to the action of Aroclor 1254 or Aroclor 1248 in a closed system at 325°C. (617°F.) for 848 hours showed no pitting and the corrosion rate, as measured in inches of penetration per year, was 0.0021.

Water and Moisture Proofness

The Aroclors are water proof. When impregnated into porous rigid bodies they are effective water and moisture proofers. Special Aroclor compounds are available for moisture-proofing such articles as paper and radio resistors and for water-proofing articles such as abrasive wheels.

STANDARD CONTAINERS

		50 gal. Drums
Aroclor.....	1248	500 lbs. net
Aroclor.....	1248	500 lbs. net
Aroclor.....	1254	500 lbs. net
Aroclor.....	1268	500 lbs. net
Aroclor.....	4468	500 lbs. net
Aroclor.....	2568	drums, 396 lbs. to 426 lbs. net.
Aroclor.....	1269	bags, 200 lbs. net. barrels, 400 lbs. net.

MONS 081241

Solubility of the Aroclors In Various Solvents

(Figures Represent Grams of Aroclor per 100 cc. Solvent)

TYPE OF SOLVENT	AROCLOR 1248		AROCLOR 1254	
	Cold	Hot	Cold	Hot
<i>Chloro Derivatives</i>				
Chloroform	S*	S*	S*	S*
Carbon Tetrachloride.....	S	S	S	S
Ethylene Dichloride.....	S	S	S	S
Trichloro Ethane.....	S	S	S	S
Trichloro Ethylene.....	S	S	S	S
Tetra Chloro Ethane.....	S	S	S	S
Mixed Amyl Chlorides.....	S	S	S	S
Mono Chlorobenzene.....	S	S	S	S
<i>Ketones</i>				
Acetone.....	S	S	S	S
<i>Aldehydes</i>				
Formaldehyde (40%).....	I*	I*	I*	I*
Furfural.....	S	S	S	S
<i>Amines</i>				
Aniline.....	S	S	S	S
Pyridine.....	138.5@30°C.	440@99°C.	114@81°C.	495@100°C.
<i>Drying Oils</i>				
Tung Oil.....	S	S	S	S
Linseed Oil.....	S	S	S	S
<i>Acids</i>				
Acetic Acid.....	S	S	S	S
Oleic Acid.....	S	S	S	S
<i>Miscellaneous</i>				
Nitro Benzene.....	S	S	S	S
Carbon Disulfide.....	S	S	S	S
Water.....	I	I	I	I

*NOTE: S signifies very soluble or miscible in all proportions.
I signifies insoluble.
P.S. signifies partially soluble.

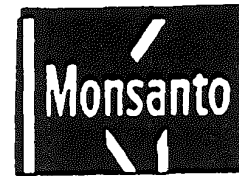
MONS 081242

Solubility of the Aroclors In Various Solvents

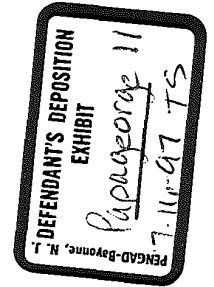
(Figures Represent Grams of Aroclor per 100 cc. Solvent)

TYPE OF SOLVENT	AROCLOR 1248		AROCLOR 1254	
	COLD	HOT	COLD	HOT
<i>Hydrocarbons</i>				
Mineral Spirits.....	S*	S*	S*	S*
Gasoline.....	S	S	S	S
Kerosene.....	S	S	S	S
Paraffin.....	—	S@50°C.	—	S@50°C.
Benzene.....	S	S	S	S
Toluene.....	S	S	S	S
Xylene.....	S	S	S	S
Turpentine.....	S	S	S	S
Pine Oil.....	S	S	S	S
<i>Hydroxy Derivatives</i>				
Methyl Alcohol.....	48.5@29°C.	88.5@60°C.	15@26°C.	22.2@65°C.
Ethyl Alcohol (Formula 3A)...	23.3@29°C.	80.0@70°C.	10@27°C.	28 @75°C.
Normal Butyl Alcohol.....	S	S	S	S
Amyl Alcohol.....	S	S	S	S
Glycerine.....	1*	1	1	1
90% Phenol.....	194@30°C.	S@99°C.	P.S.*	Slowly Soluble
<i>Ethers</i>				
Ethyl Ether.....	S	S	S	S
Cellosolve Acetate.....	S	S	S	S
<i>Ether Alcohols</i>				
Cellosolve.....	S	S	S	S
Carbitol.....	224@31°C.	307@99°C.	173@26°C.	259@ 98°C.
p-p' Dihydroxy Ethyl Ether.....	16.9@23°C.	19@99°C.	8@80°C.	10@100°C.
<i>Esters</i>				
Castor Oil.....	S	S	S	S
Methyl Acetate.....	S	S	S	S
Ethyl Acetate.....	S	S	S	S
Butyl Acetate.....	S	S	S	S
Amyl Acetate.....	S	S	S	S
Ethyl Lactate.....	S	S	S	S
Diethyl Phthalate.....	S	S	S	S
Dibutyl Phthalate.....	S	S	S	S
Tricresyl Phosphate.....	S	S	S	S
Cotton Seed Oil.....	S	S	S	S
Ethylene Glycol Diacetate.....	S	S	S	S

MONS 081243



MONS 079962



aroclor

1248



MCNS 079963

aroclor
1248

M



*Reg. U. S. Pat. Off.

..... has been used successfully since 1941 as a liquid phase heat transfer medium at atmospheric pressure and temperatures up to 600°F.

The compound, essentially tetrachlorobiphenyl, is a fire-resistant and non-corrosive liquid, which does not crystallize at low temperatures. Handled properly, in well-designed forced circulation heat exchangers which avoid localized overheating damage, the fluid gives satisfactory continuous service for many years without replacement.

Most significant, Aroclor 1248 is practically non-flammable. In one installation of record, a ruptured pipe spewed the hot fluid into gas flames: the fluid failed to ignite!

For general heat transfer, Aroclor 1248 has several other important qualities: it is highly mobile and can be readily pumped at temperatures as low as 50°F. If cooling is necessary, the heat transfer fluid can be put through a water cooler and used as a coolant.

Aroclor 1248 transfers heat (up to 600°F.) as a *liquid*. This liquid phase heat transfer makes it unnecessary to use the expensive pressurized equipment required by a heat transfer medium that operates as a vapor. Aroclor 1248 operates safely and efficiently with gas-fired, oil-fired, or electrical heat sources. It is used successfully in the following types of applications

MONS 075964

-
- Chemical processing equipment, particularly for reacting flammable materials
 - Cooking of alkyl resins, varnishes, waxes
 - Plastics molding, extruding, calendaring
 - Rubber processing
 - Heating asphalt
 - Food processing, including potato chip and doughnut frying in vegetable oils
 - Processing titanium, magnesium, other non-ferrous metals
 - Fabrication of magnesium and aluminum honey-comb structures for aircraft
 - Indirect heating in dyestuff manufacture
 - Heating of corrugating rolls
 - Indirect heating of distillation equipment
 - Saponification of fats
 - Calcining ovens
 - Impregnation and lamination of fibrous materials

MONS 079965

physical properties

APPROXIMATE



TABLE I

Appearance	Practically colorless mobile liquid		
	Temperature		
	[°] Centigrade	[°] Fahrenheit	
Absolute density, g./ml.	1.44	30	86
	1.41	60	140
	1.37	100	212
	1.27	200	392
	1.17	300	572
Absolute viscosity, centipoises	112.0	30	86
	17.5	60	140
	4.2	100	212
	0.99	200	392
	0.47	300	572
Thermal Conductivity, Btu./hr./sq. ft./°F./ft.	0.0571	30	86
	0.0564	60	140
	0.0555	100	212
	0.0534*	200	392
	0.0512*	300	572
	*Extrapolated Data		
Spec. Volume, ml./g.	0.696	30	86
	0.709	60	140
	0.728	100	212
	0.787	200	392
	0.860	300	572

CONTINUED

MUNS 079966

(Table I, cont.)

		*Celsius	*Fahrenheit
Spec. Heat, cal./g./°C.	0.283	50	122
	0.297	100	212
	0.326	200	392
	0.355	300	572
Vapor Pressure, mm. Hg.	0.00037	37.8	100
	0.16	100	212
	2.9	150	302
	18.0	200	392
	350.0	300	572
Distillation Range, ASTM D-20		345-385	652-725
Flash Pt., Cleveland Open Cup, ASTM D 92-45		193-196	379-384
Fire Pt., Cleveland Open Cup, ASTM, D 92-45	None	—	—
Pour Pt., ASTM, D-97		-7	19.4
Average Coefficient of Expansion cc./cc./°F.	0.00037	-17.8 to 37.8	0 to 100
	0.00038	37.8 to 93.3	100 to 200
	0.00041	93.3 to 149	200 to 300
	0.00044	149 to 204	300 to 400
	0.00047	204 to 260	400 to 500
	0.00052	260 to 316	500 to 600

PHYSICAL CHARACTERISTICS of AROCLOL 1248

A complete knowledge of the physical characteristics of heat transfer media is highly essential to their satisfactory application in a heat exchanger. These physical constants have a major bearing on the equipment design, its maintenance, and its operation.

The following figures and charts give basic physical data on Aroclor 1248.

MCNS 079967

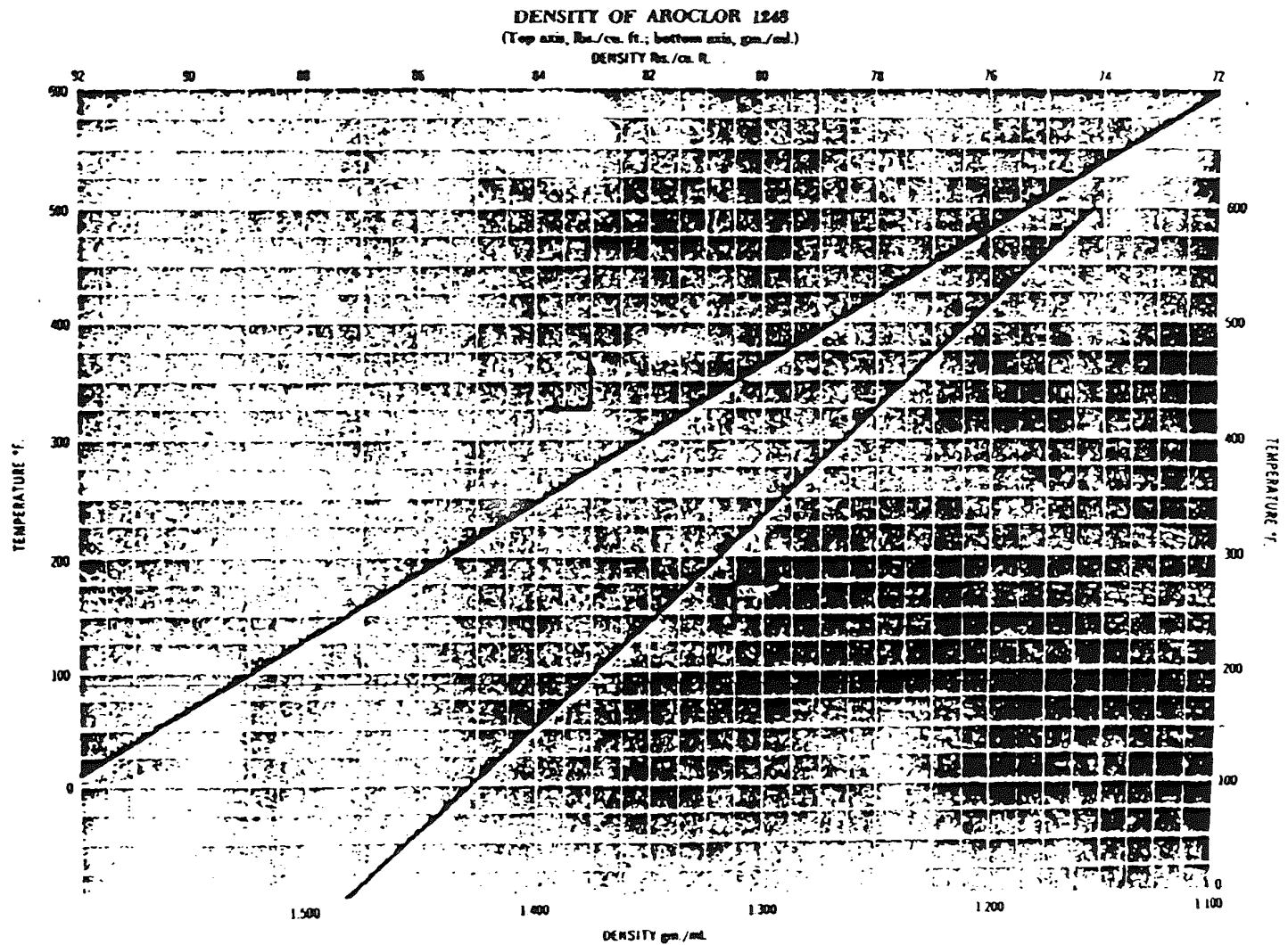


Figure 1

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VISCOSITY OF AROCLOR 1248

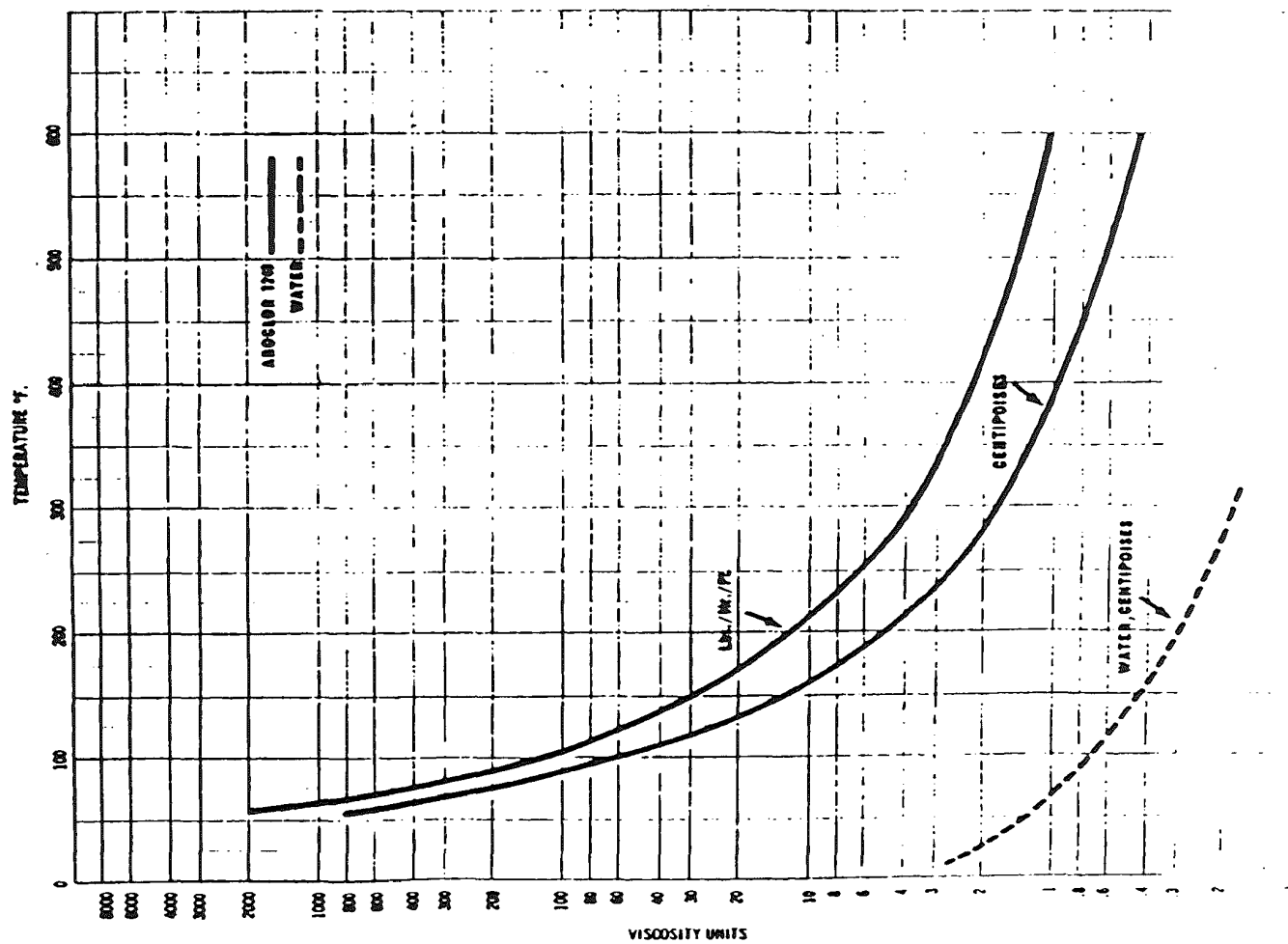


Figure 2

MONS 079969

VISCOSITY OF AROCLOR 1248
(Saybolt Universal Seconds)

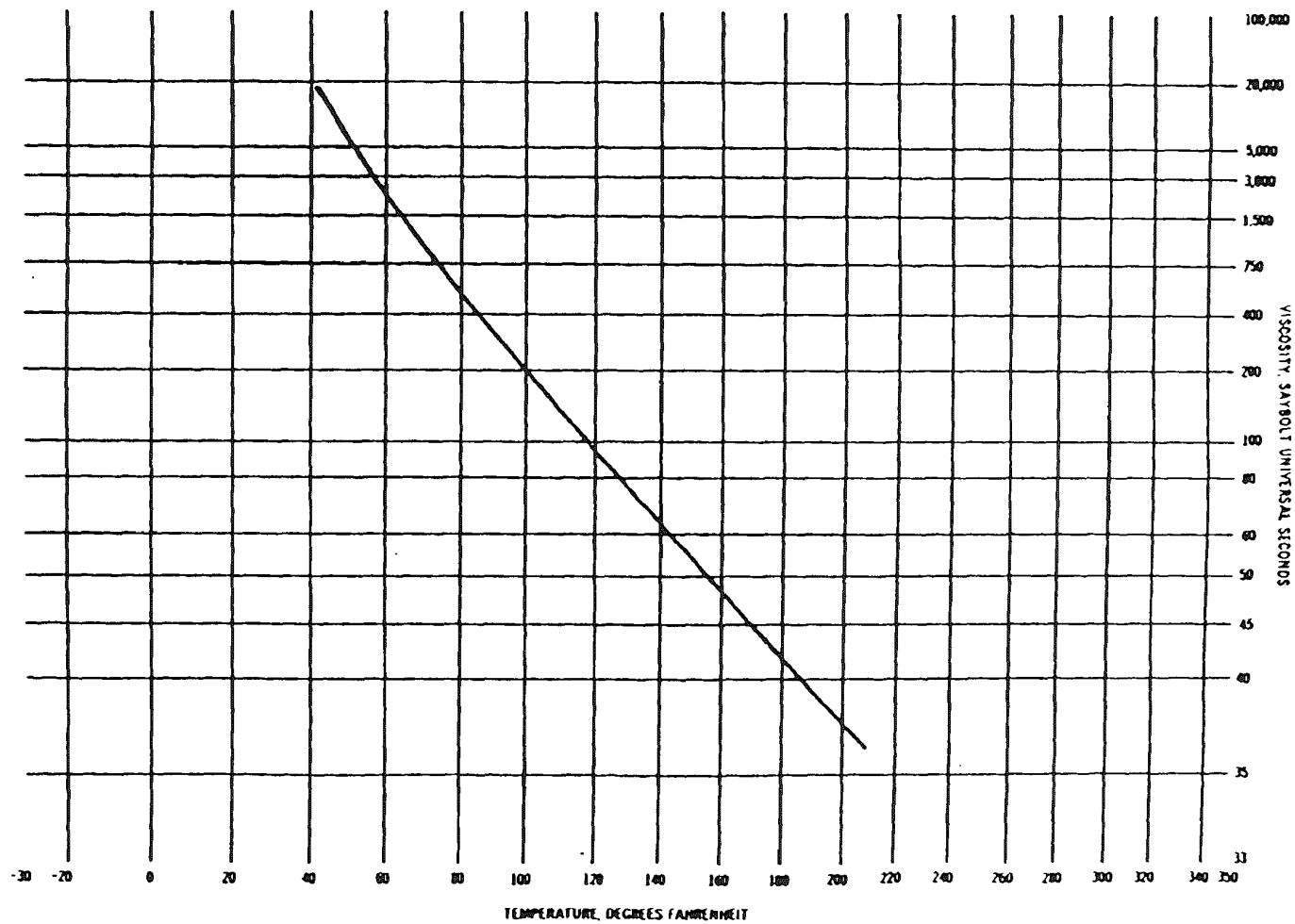


Figure 3

MUNS 079970

HEAT CAPACITY

and Its Relationship to Density

Systematic errors exist in the various accepted procedures for making specific heat determinations. Consequently values may vary depending upon the procedure used. In practical operation, it frequently appears that the values for Aroclor 1248 shown in Figure 4 are somewhat low. Consequently, although these values have been accurately determined, they may be regarded as conservative.

When comparing the specific heat values of Aroclor 1248 with corresponding values for other heat transfer fluids, it is important to note that the density of Aroclor 1248 is much higher, relatively, than the density of other liquids used for heat transfer. Accordingly, when comparison of heat capacity is made on a

volume basis (which is most pertinent in equipment design and efficient operation) the heat capacity of Aroclor 1248 shows itself to better advantage than by direct comparison of specific heat values.

Although specific heat values are important, they represent only one of several important constants that enter into the equations for calculating over-all heat transfer efficiency.

Through the use of these conservative heat capacity values, it is possible that equipment engineered from such data might be slightly "over-designed." This may be one of the factors that accounts for the exceptionally good operating performance of a number of highly successful commercial applications.

MCNS 079971

SPECIFIC HEAT OF AROCLOR 1248

(Btu. per lb. per degree F.)

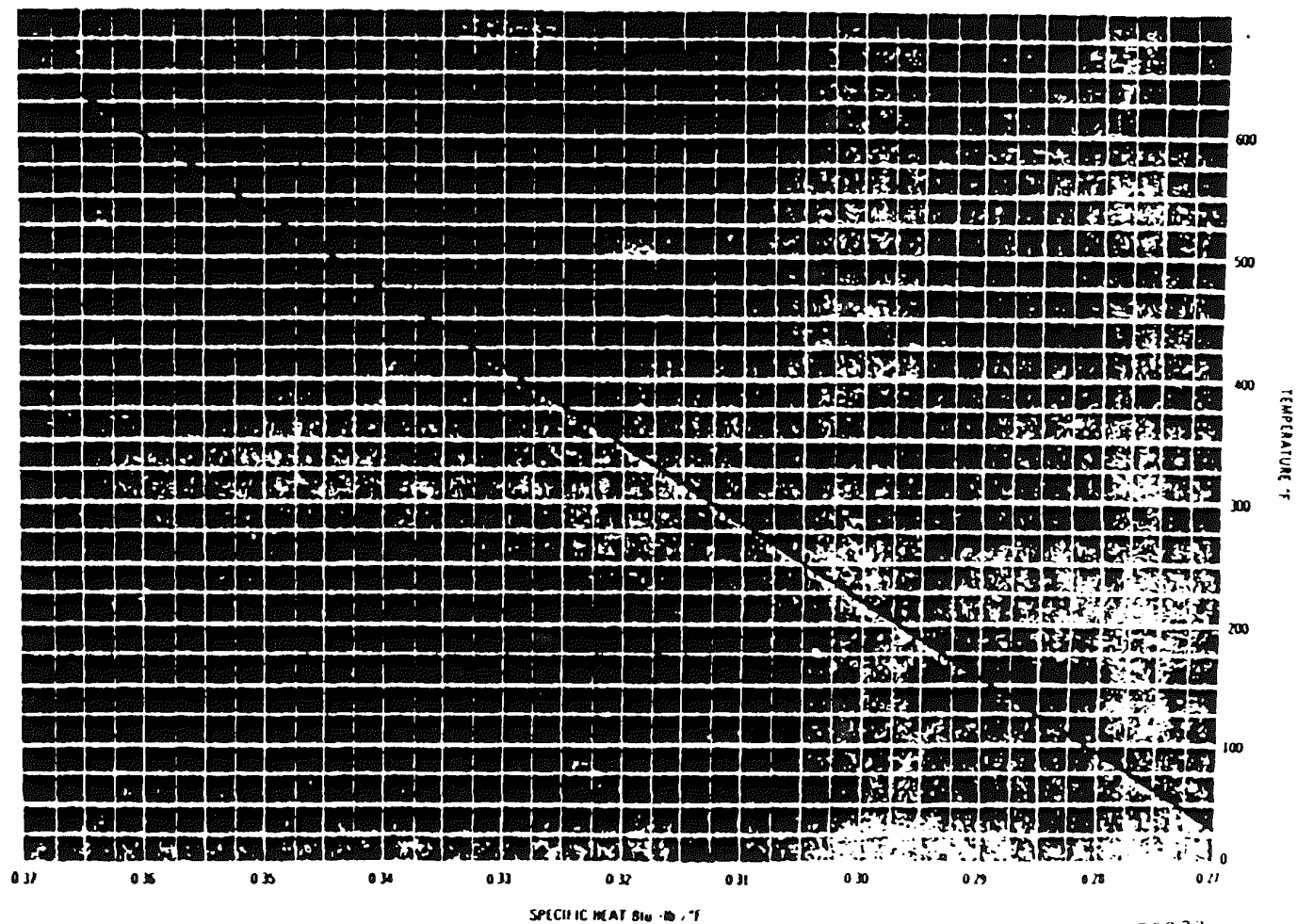


Figure 4

MONS 075972

TABLE II
HEAT CONTENT
of Aroclor 1248

Temperature		Specific Heat Btu./lb./°F.	Heat Content Btu./lb.
°C.	°F.		
0	32	.269	0.0
10	50	.272	4.85
38	100	.280	18.65
66	150	.288	32.85
93	200	.295	47.43
121	250	.303	62.38
149	300	.311	77.58
177	350	.319	93.48
204	400	.327	109.66
232	450	.335	126.21
260	500	.343	143.17
288	550	.351	160.52
316	600	.359	178.27

THERMAL CONDUCTIVITY and VISCOSITY

The thermal conductivity values of Aroclor 1248 are shown in Figure 5. The curve shows this value over the operating temperature range, from 50°F. to 600°F., of Aroclor 1248.

As freshly charged into a heat exchanger, Aroclor 1248 has an initial viscosity of 74 (S.U.S.) at 130°F. which corresponds to a viscosity of approximately 5000 (S.U.S.) at 50°F. — which temperature is assumed for practical purposes to be about the limit at which Aroclor 1248 can be conveniently pumped with a centrifugal pump.

The following table shows a comparison of the initial viscosity and the viscosity after a year's continuous service at 600°F. in a LaMont forced circulation heater:



TABLE III

	Original	After one Year of service at 600°F.
Appearance	Colorless Liquid	Dark Brown Liquid
Specific Gravity, 65° C.	1.410	1.418
Viscosity, S. U. S. at 130°F.	74.0	83.5

Although Aroclor 1248 tends to darken in use, this darkening is not harmful and does not indicate decomposition. In actual use at Monsanto, it has not been found necessary to replace the fluid after seven years of continuous use; additional fluid is only added as necessary to make up spills or leaks.

In Figure 6, the horizontal line indicating viscosity limit of pumpability at 50°F. shows that the rate of viscosity increase based on a year's continuous service should permit Aroclor 1248 to serve approximately four years before increased viscosity may interfere with its pumpability when cold. In practice, Aroclor 1248 has given satisfactory pumpability for much longer periods. A simple S.U.S. viscosity determination by the ASTM-D-88 method can be used for periodic checks on the fluid

THERMAL CONDUCTIVITY OF AROCLOR 1248

(Dotted extension indicates extrapolated data)

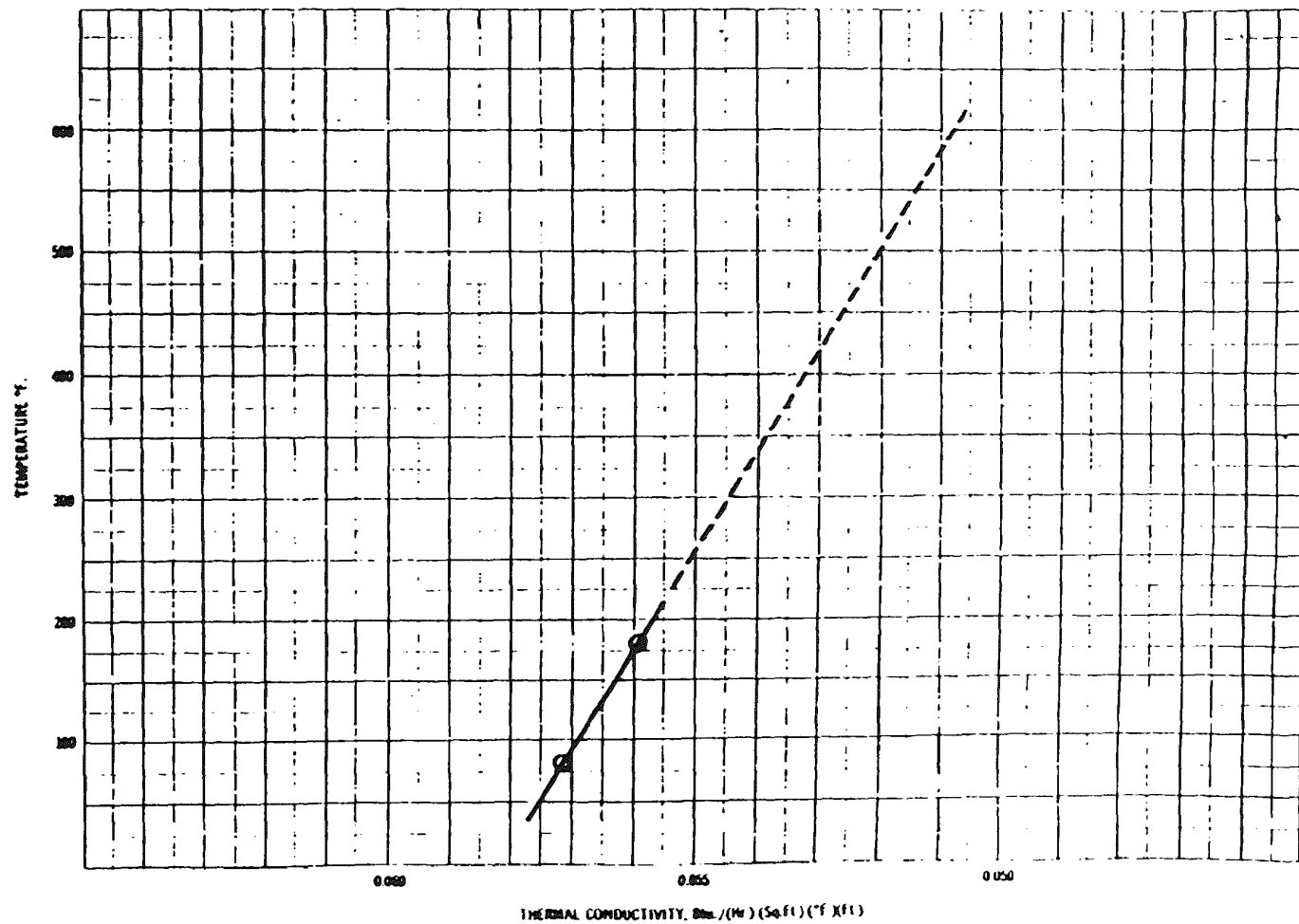


Figure 5

MLNS 079575

EXPECTED MINIMUM SERVICE LIFE IN A
FORCED CIRCULATION HEATER

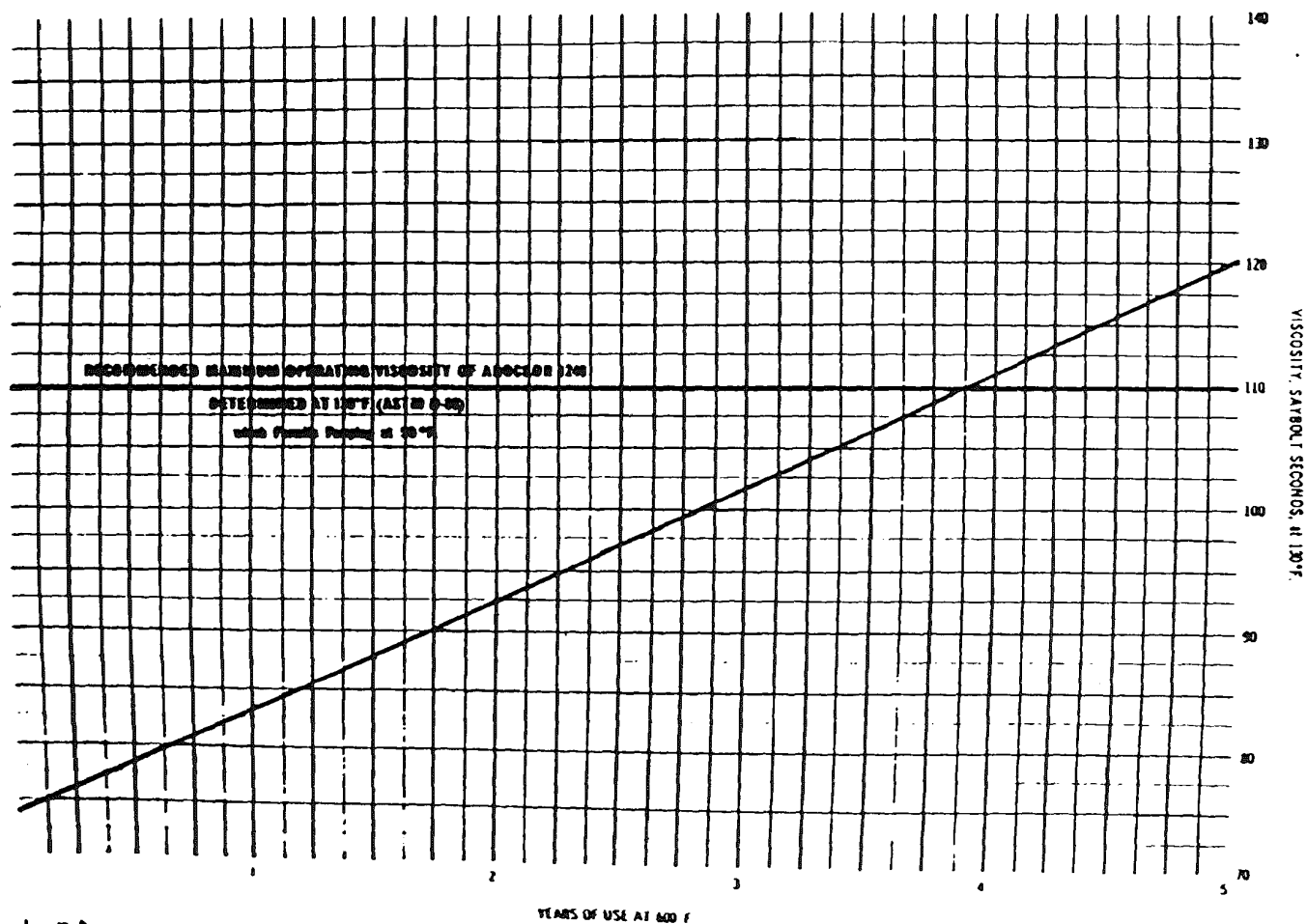


Figure 6

YEARS OF USE AT 600 F

MUNS 075926

11

STABILITY

Aroclor 1248 is an extremely stable chemical compound. Tests over long periods of time have shown that 600°F. is a safe maximum temperature for continuous operation in heaters that are properly designed and operated to eliminate intense, localized overheating. At this temperature the fluid is 32°F. below the initial temperature of its boiling range, and consequently remains a liquid.

Near its boiling point Aroclor 1248 tends to dehydrohalogenate to a very slight but measurable degree. If this occurs as a result of accidental overheating, the small amount of HCl gas evolved tends to pass through the vent tank without harm to the equipment provided that the system is dry.

Experimental observations using ideally-suited heat exchangers operating at a temperature of 650°F. with imposed nitrogen pressures of 30 and 70 psig. showed that application of pressure did not prevent this small amount of thermal decomposition, which also occurs when the material is heated above 600°F. at atmospheric pressure.

When heated continuously at 650°F. under nitrogen pressure a gradual increase in the viscosity of the fluid occurs indicating that its service life would be limited to about 6 months to one year.

Results of operating at 600°F., however, without imposed nitrogen pressure indicate Aroclor 1248 can be heated continuously at this temperature for about 4 years before any viscosity increase could be expected to interfere with its pumpability at 50°F. which is slightly below normal room temperatures.

Provision should be made to prevent water contamination of the system. If the system becomes contaminated with water, any HCl liberated by localized overheating may dissolve in the water film which will float on top of Aroclor 1248 in the expansion tank. The acidic solution thus formed can cause corrosion. It is recommended that moisture be eliminated from the expansion tank by installing a moisture trap or by sealing the tank and applying 15 to 30 psig. of nitrogen gas. With exception of the expansion tank, the system should be kept full of Aroclor 1248 at all times to prevent formation of air pockets where moisture may condense when the system cools off between periods of operation.

Many years of practical operating experience have shown that Aroclor 1248 is virtually non-corrosive to valves, piping, tanks, and jackets made of cast steel, steel, or stainless steel. In actual use, brass valves have been used satisfactorily.

MONS 079927

SAFETY of OPERATION

Aroclor 1248 can be considered a non-flammable liquid; no fire point is obtained by the Cleveland Open Cup method on heating to its boiling point (650°F.). The spontaneous ignition temperature⁽²⁾ is 1,290°F.

In actual use, the following reported accident in a heating system demonstrates the fire resistance of Aroclor 1248 and the freedom it offers from the hazard of fire propagation. An operator's failure to start the circulation pump when the gas heater was on resulted in excessive coil temperatures. The line containing Aroclor 1248 sagged into the fire chamber. A weld ruptured and Aroclor 1248 poured into the red-hot fire chamber in contact with the flame. Dense smoke and fumes arose from the heater but there was no external fire. After the gas flame was cut off, the smoking stopped.

Insurance authorities allow the use of Aroclor 1248 heaters in many locations with a minimum of protection. No fire walls are required to isolate the heaters.

Aroclor 1248 has a low vapor pressure. In systems that employ a vented expansion tank, the loss due to evaporation is not measurable. If Aroclor 1248 in the expansion tank would reach a temperature of

288°F., the vapor pressure of the fluid would be only 1 mm. of Hg.

SAFETY OF HANDLING

Aroclor 1248 is an inert, unreactive liquid. If it is spilled on the skin, there are no noticeable ill effects. It is advisable, however, to wash the skin with soap and water after contact.

A skin burn resulting from accidental contact with hot Aroclor 1248 should be treated in the normal manner for hot oil burns. Any liquid adhering to the burned area need not be removed immediately unless treatment of the burn demands it. If the burn must be cleaned, soap and water or repeated washings with a vegetable oil (olive oil) may be used.

The vapors emitted by Aroclor 1248 heated to elevated temperatures are injurious on prolonged exposure and should not be breathed. It is indicated that 2.0 mg. of Aroclor 1248 per cubic meter of air is the maximum safe amount permissible in workrooms. In commercial heat transfer installations, it is presumed that Aroclor 1248 will be used in a closed system free from leaks. Accordingly, there should be little or no opportunity for workers to come in contact with Aroclor 1248 vapors.

⁽²⁾ A bibliography appears on page 32.

MUNS 079978

design features

HEATER

The most significant factor to remember when selecting or designing a heat exchanger for Aroclor 1248 use is this:

Aroclor 1248 transfers heat while in liquid form, at the maximum recommended temperature of 600°F. for continuous operation, which is approximately 50°F. below the boiling point. Consequently, Aroclor 1248 does not form vapor to accelerate convection circulation. Ordinary fire-tube or water-tube heaters which depend solely upon convection perform satisfactorily only at relatively low temperatures.

When temperatures of 500-600°F. are required, a forced circulation type heater is recommended. A satisfactory type of heater design would consist of a specified number of tubes in parallel, properly oriented to provide a high velocity fluid flow of 8 to 10 feet per second. These should be spaced to permit uniform heat absorption throughout their entire length. A typical construction is shown in Figure 7.

In its fabrication, the heater should be ASME Code all-welded construction, conforming to state and local ordinances. Tube joints, which in an ordinary steam heater would be the expanded type, must be seal-welded to prevent leakage. All connections larger than ¾" should be flanged connections, since ordinary threaded pipe connection is not suited for Aroclor 1248 service. Spiral-wound stainless steel and asbestos combination is recommended for sealing joints and plugs.

Drain valves should be installed at all low points on the heater and the valves must conform with ASME requirements for "blow down" valves.



MCNS 079979

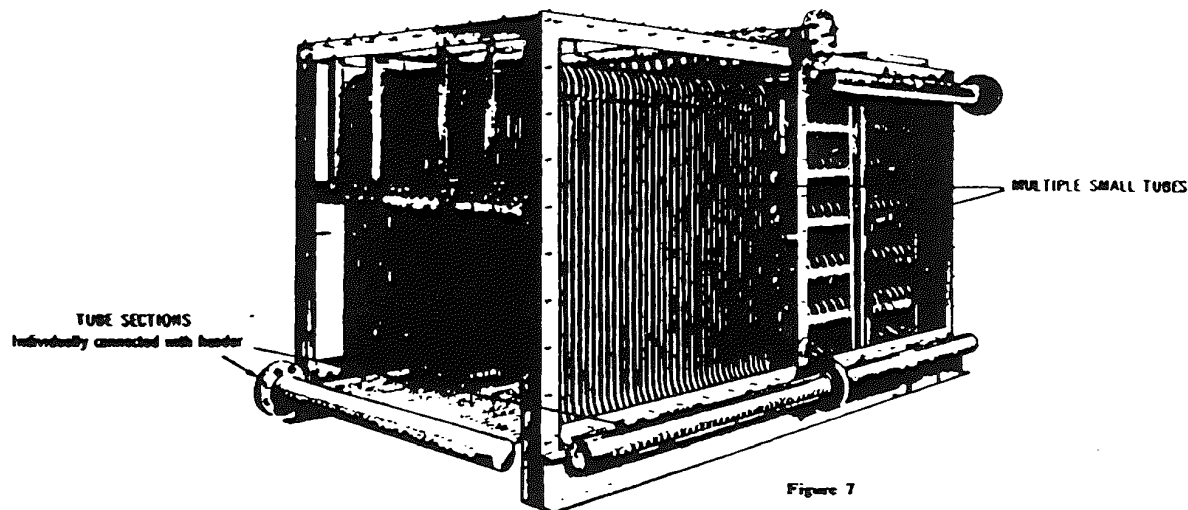


Figure 7

Since a heater operating on Aroclor 1248 is completely filled with liquid, costly liquid-level controls and condensate return pipes, fittings, traps, etc. are completely eliminated.

Heaters can be provided with any desired kind of firing. Portable and small size stationary units are frequently electrically heated; larger units may be gas- or oil-fired. In installations where an open flame presents a fire hazard, to meet insurance requirements the heater may be installed in a separate building with piping carrying the hot Aroclor 1248 to the point of use. Properly constructed transmission pipes may extend for hundreds of feet.

HEATER EFFICIENCY

Forced circulation heaters with integral economizers will show

an efficiency of from 75 to 80%. Heaters of the straight connector type show efficiencies of 65 to 75%, depending upon the discharge temperatures.

HEATER CAPACITIES

Heaters using Aroclor 1248 (gas- or oil-fired) are available in output capacities ranging from approximately 250,000 Btu. per hour to large units rated over 10 million Btu. per hour. A heat flux density (or heat energy input) of approximately 5,000 Btu. per hour per square foot of tube surface is regarded as satisfactory.

For lower output rate, electrically-heated units are favored, employing watt densities of 12 to 16 watts per square inch of element area.

MUNS 079980

THE USERS

The "users" or recipients of the heat at the point of processing can be any type of heating pan, platen, jacketed kettle, or coils of steel or stainless steel construction. Ordinary low pressure construction is satisfactory, since the pressure imposed on the Aradur 1248 system exceeds 50 psig. In the user, however, it is important that all-welded construction be used. Threaded connections may allow leakage of the hot fluid. As in the heater, all connections $\frac{1}{2}$ " and over should be flanged and all joints sealed with spiral wound stainless steel and asbestos gasket material. Alloy bolts should be used to secure flanges. A typical system with several users is shown in Figure 8.

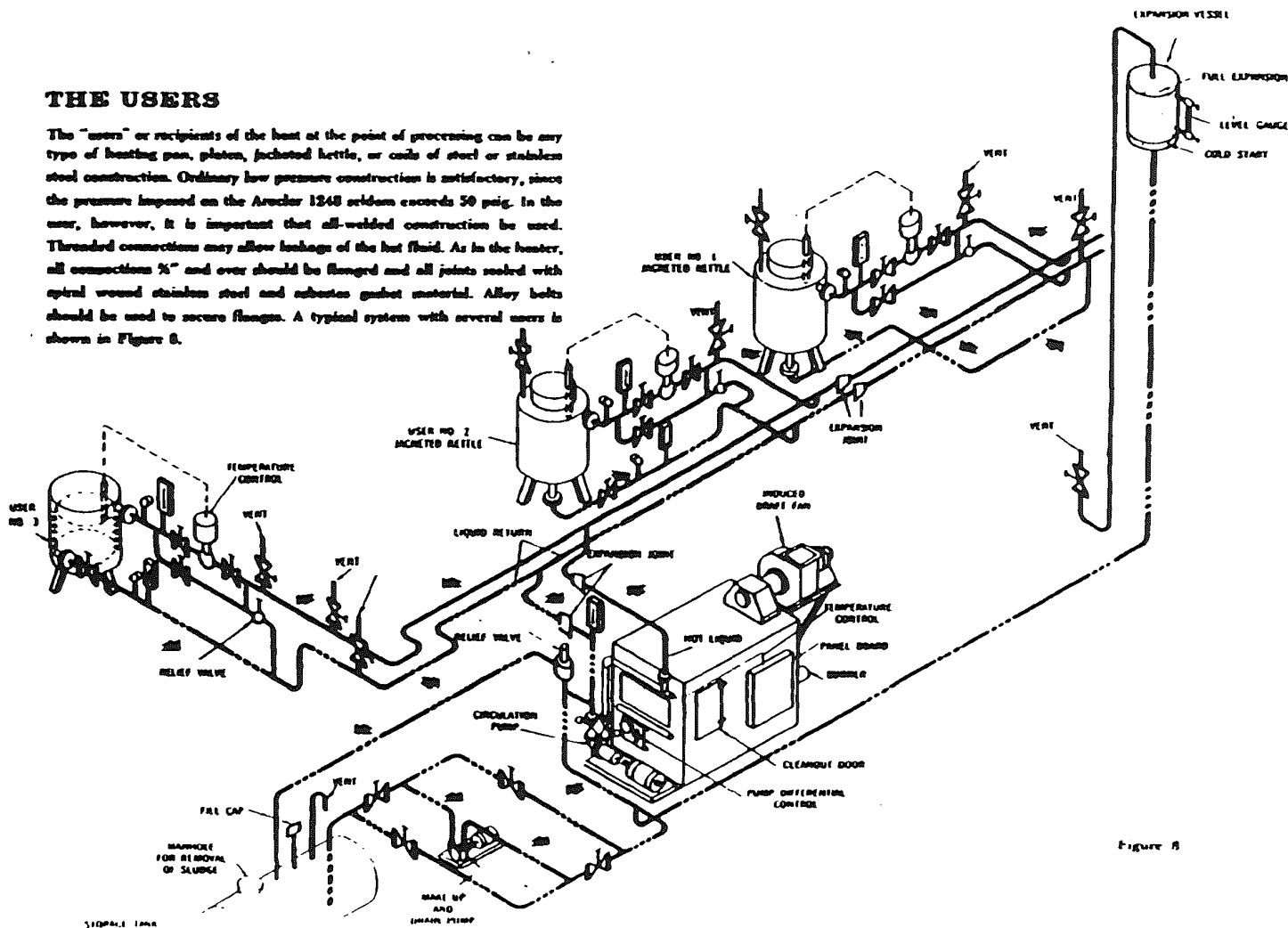


Figure 8

MUNS 079981

THE PUMP

For most systems, cast-steel centrifugal pumps with water-cooled stuffing box and bearings are to be preferred. However, high temperature centrifugal pumps with mechanical seals are now available which give excellent performance. In some installations, immersion pumps have been used. Whatever type is selected, the pump capacity and pressure head must be sufficient to circulate the volume of fluid at the rate the particular installation demands.

To avoid shaft trouble and leakage at the seals, it is important to provide adequate expansion joints and to support the piping in a manner to avoid stresses on the body of the pump. Direct-connection pumps driven by 1,750 rpm. motors are most commonly used. Each pump should be fitted with a positive differential control to switch off the burner in case of pump failure.

When a new system is first put into operation, a slight leakage may be noticed at the pump. It is not advisable to tighten the pump gland, however, until the system has heated up close to the temperature of operation.

PIPING LAYOUT

The most important factors in the piping layout for Aroclor 1248 systems are (a) proper sizing for the required flow rate and (b) minimizing pressure drop. Because the system will undergo temperature changes, adequate expansion joints and loops to relieve expansion and contraction stress are essential.

Preferably, all pipe lines and connections should be of extra heavy or Schedule 80 welded construction meeting A.S.M.E. requirements. However, Schedule 40 welded pipe construction is often employed. Flanged joints should be used as sparingly as possible to minimize potential leak points.

All valves and controls should be cast steel construction with stainless steel seats. Pipe lines should be well insulated and those exposed to temperatures below 70°F. should be steam jacketed.

All high points in the piping system should be provided with vent valves; all low points should have drain connections. Piping should be well anchored at frequent intervals, particularly near expansion loops, to prevent vibrations.

Figure 9 shows a typical piping diagram that illustrates the important features of an Aroclor 1248 piping system. These may be varied to suit the installation.

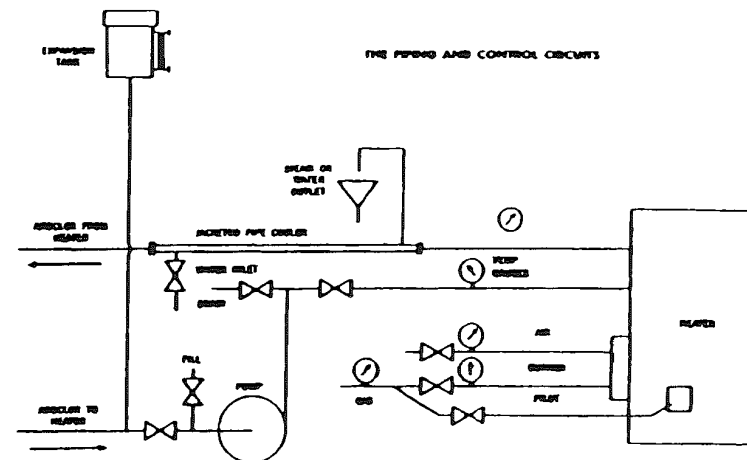


Figure 9

MONS 079982

THE EXPANSION TANK

The expansion tank should be large enough to accommodate about 20% of the total volume of the entire system, including the fluid content of the heater, piping, and all heat-users. Tank should be sized to be $\frac{1}{4}$ -full when system is cooled to 70°F. and $\frac{3}{4}$ -full when system is at maximum operating temperature. Expansion tank should be fitted with a sight glass at the "full" range and a float-operated low-level switch to shut off burner in case of accidental fluid loss in the system.

The expansion tank should be mounted on a platform high enough to support the liquid reservoir at least six feet higher than the highest point in the piping system.

THE FEED and DRAIN PUMP

To eliminate manual filling and draining of the heating system, it is recommended that a small 2-to-5 gpm. positive displacement pump be installed at some convenient point to pump the Aroclor 1248 into or out of the system.

CONTROLS

Controls for heating systems using Aroclor 1248 should be installed both on the heater itself and on the heat-using units. A wide variety of thermo-operating controls are available and any reliable standard equipment is satisfactory.

Heater controls should be installed to regulate the firing mechanism in direct proportion to the required output. These controls should increase or decrease the heat input to maintain the Aroclor 1248 at the operating temperature required by the heat-demand of the user. Small units may be operated satisfactorily by relatively simple "on-off" or "high-low" controllers; larger units may operate more uniformly if equipped with modulating temperature controls.

User Controls should be installed to regulate the flow of the heat transfer fluid in direct proportion to the heat-consumption of the heat-using equipment. In a multiple-user sys-

tem, separate controls should be installed on each consuming unit, to assure the proper heat-delivery.

Safety Controls. In addition to activating controls, the heater must also be fitted with the proper safety controls to meet the A.S.M.E. requirements. Safety controls should include:

1. A high temperature limit control operating at the heater outlet to shut off the burner in the event of an excessive temperature rise.
2. A suitable low-limit temperature control to hold the burner at low fire until the Aroclor 1248 in the system reaches a temperature level of 180°F.

The low limit temperature control is essential because the viscosity of Aroclor 1248 is rather high at normal room temperature. To avoid localized overheating upon start-up, it is not advisable to apply full heat from the burner until all the fluid in the system has attained a viscosity that allows good flow and unimpeded circulation. Cold start-ups require slow up-heats.

Burners should be equipped with automatic ignition controls and flame failure controls. In wide-range firing operations, an over-fire draft control will increase the economy of operation. Induced draft fans are another factor which should be considered as a means of avoiding the expense of high chimneys.

Where they are needed throughout the system, good quality recording or indicating gauges should be installed.

COOLING EQUIPMENT

Where fast reduction of temperature is required, suitable air- or water-cooling installations may be used. If the cooler is to be a water-type unit, it is suggested that stainless steel tubing be used for the coils to avoid corrosion on the water side. If a cooler is installed in the system, low temperature limit controls should also be installed to avoid excessive cooling that might raise the viscosity to the point of impeding the circulation in the system.

FILTERING EQUIPMENT

When heating systems operated on Aroclor 1248 are run continuously near the recommended maximum temperature of operation (600°F.), it is advisable to provide a filtering device that can be attached to the drain line of the storage tank. In this way discrete particles of dirt that may get into the system can be filtered out periodically. This is an advisable maintenance step since it will eliminate the danger of dirt clogging the valve seats or lodging in parts of the control mechanisms.

A small portable filter such as those manufactured by Honan-Crane Corporation (Lebanon, Ind.) or Sparkler Manufacturing Company (Mundelein, Ill.) is quite satisfactory.

CONNECTIONS and GASKETS

To minimize the possibility of Aroclor leakage, welded rather than threaded screw connections should be used. All connections ½-inch and over should be of the flanged type, fastened with alloy bolts; spiral-wound gaskets of corrugated stainless steel and asbestos should be used with flanged connections. For three-inch lines, 300 pound flanges fitted with eight three-quarter inch bolts should be employed. As a joint compound, a product like "Q" Seal* has been found useful. In all cases, steel connectors are recommended for all instruments and controls.

TESTING THE SYSTEM

When a new system has been installed it is essential to test for leaks.

Testing with air should be avoided because of hazard of rupturing pipes or jackets. Testing with water is not recommended because it is difficult to remove residual moisture from the system which should be kept dry.

Halogen Testing for leaks is the recommended procedure. Introduces one pound of Freon F-12 or F-22 for each fifty cubic feet of volume of the heater and system. Carefully introduce air not exceeding 10 psig. of pressure. With up to 10 psig. of air pressure, the concentration of Freon will be sufficient to give sensitive test results.

Attach a halide torch to an acetylene tank and light it. Using the ¼ inch hose as a probe, explore for leaks by passing the end of the hose along seams and joints. If a leak is present, the escaping Freon will be drawn

into the acetylene flame turning it green. A large leak will produce a violet color.

CLEANING THE SYSTEM

After testing for leaks and making any required repairs, the system must then be cleaned.

A new system will contain dirt, mill scale and other foreign particles. Unless removed, these particles will be suspended by the Aroclor. They may then lodge in valves, controls and mechanical equipment and cause faulty operation.

Purchasers of the heating equipment should request their suppliers to clean the equipment as thoroughly as possible, using brushes and wiping rags.

Where state or local codes require hydrostatic testing and cleaning with water, the procedure described by card No. 1 may be used. However, it is not easy to remove residual moisture from the system. Since moisture is not desired in the system, testing and cleaning with water should be avoided whenever it is possible to do so.

Testing for leaks should be done as described above using Freon. After repairing any leaks, fill the system with Aroclor 1248, warm the fluid and circulate it thoroughly.

The Aroclor will serve better than water for hydrostatic testing and cleaning and will keep the system free from excess moisture. Since the Aroclor will pick up dirt and extraneous particles, it will be necessary to clean the fluid by filtration. To prevent filter arrangements, including screens from interfering with the required flow of Aroclor through the system, the filters must not be installed permanently in the line of flow. Temporary strainers in the suction side of the pump should be inspected frequently during initial start-up and removed when the system has proven clean.

The Aroclor should be cleaned thoroughly using a by pass filter, either a platten frame press fitted with dry filter paper and a thin bed of Attapulgus earth, or a convenient portable earthen cartridge type filter. Periodic use of this filtration equipment should assure that the Aroclor and the heating system are clean at all times.

In the event that the engineer chooses to carry out testing and cleaning using water, it is very important that all moisture be purged from the system during the early hours of operation. Details are given on Card No. 1. Following hydrostatic testing, periodic use of the filter equipment referred to above is desirable to keep the fluid and system clean

* A product of Quakley Co., Inc., 50 W. 115th St., New York, N. Y.

GENERAL RECOMMENDATIONS for Operation and Maintenance

The following recommendations are primarily guides for the manner of using Aroclor 1248 in an operating system. They are supplemental to the equipment manufacturer's own recommendations for operation and maintenance that relate to the heaters or the heat-using installations themselves. The recommendations for start-up, shut-down, precautions in event of power failure, and periodic check-ups on the fluid and equipment apply as generally accepted practice on all types and sizes of systems. By following these recommendations, the trouble-free service life of the heat transfer fluid will be increased.

START-UP

When systems have been shut down for week-ends or over-night and the fluid is cooled to room temperature, follow this start-up procedure:

1. Start the circulating pump and check the expansion tank to make certain the Aroclor 1248 is at the proper cold-start level (Tank should be $\frac{1}{2}$ -full.)
2. Start burner at minimum flame setting and continue full circulation until Aroclor 1248 is heated to 180°F. when measured on the return side of the heater.
3. Turn heater up to full heat.

SHUT-DOWN

The following procedure will eliminate overheating of the fluid when shutting down:

1. Shut off burner completely with circulating pump still operating. Continue to run the circulating pump at full head for at least $\frac{1}{2}$ hour to dissipate high residual heat in the combustion chamber of the burner.
2. Shut off circulating pump at the end of $\frac{1}{2}$ hour and switch off all heater electrical controls.

PRECAUTIONS IN COLD WEATHER

When heat exchanger is exposed to ambient temperatures below 50°F., it is recommended that unit not be shut down. It is recommended that the burner be turned low and the fluid circulated continuously at about 200°F. The unit will then be "at ready" for immediate high temperature operation.

PRECAUTIONS IN CASE OF POWER FAILURE

In case of power failure, the burner circuit is interrupted by the heater controls. When power comes on, the circulating pump should first be run for a few minutes to eliminate any vapor pockets that might have been formed by the fluid's being held static in the hot combustion chamber. If there is no knocking in the piping system, full-fire may be resumed immediately, if the fluid temperature is above 180°F.

PERIODIC CHECK-UPS

The regular maintenance inspection schedule should include the equipment manufacturer's recommendations and also inspection of the heat transfer fluid. The following is a listing of check points.

1. Lubrication of moving parts.
2. Operating fidelity and accuracy of readings of safety controls and temperature limit controls.
3. Inspection of heater tubes, burner, refractory linings.
4. Periodic cleaning of heater surfaces.
5. Inspection of water cooling at the circulating pump.
6. Regular repacking of stuffing boxes according to the manufacturer's recommendations.
7. Semi-annual or annual sampling and analysis of Aroclor 1248.

Under normal operating conditions not affected by frequent power failures or accidental overheating, when Aroclor 1248 is operated at 600°F. it should not be necessary to check on the condition of the fluid more often than once or twice a year.

The analysis for fluid condition is a simple determination of viscosity. The information given in Figure 6 serves as a guide to estimate the condition of the fluid, according to viscosity values. Most users do their own testing; some have the viscosity determination made by an outside laboratory.

Customers can have their fluid tested by Monsanto free of charge. A one-quart sample is required, and sample should be carefully packed to avoid breakage in shipment. Samples should be shipped to:

Monsanto Chemical Company
Organic Chemicals Division Industrial Fluid Sales
St. Louis 24, Missouri

ABOVE INFORMATION APPEARS ON POCKET CARDS INSIDE BACK COVER

engineering data

Designing or purchasing equipment for a heating system to be operated with Aroclor as a medium to deliver heat into a process requires consideration of heat transfer characteristics of both the user and the heater. The actual heat which can be absorbed by a user, for example, depends upon the over-all heat transfer coefficient, heat transfer area, and a mean temperature difference between Aroclor and the material being heated. Both overall heat transfer coefficient and mean temperature difference are, in turn, affected by the flow rate of the Aroclor. This inter-relation of flow rate, heat, and temperature is usually solved by a trial and error procedure as covered in standard reference texts. The approach of Cranet⁽¹⁾ may be used to minimize or eliminate trial and error.

The following tables and graphs of physical properties and engineering data are provided as an aid in layout and design calculations for systems to be operated with Aroclor 1248 as a heat transfer fluid in the liquid phase.

Table IV lists properties useful in heat balance calculations by which the flow rate is related to the heat transferred and the temperature change of the Aroclor. This relation is also shown graphically in Figure 10.

The over-all heat transfer coefficient for the heater or user may be estimated by the methods outlined in the texts of McAdams⁽¹⁾ or Kern⁽²⁾. This is usually done by combining the individual film coefficient of the Aroclor with other coefficients and conductivities to yield the over-all coefficient. Table V contains physical properties of Aroclor as a function of temperature which are needed for calculating the Aroclor film coefficient. Table VI gives typical film coefficients for Aroclor flowing through a 0.81 inch i.d. tube. These are listed as a function of temperature and flow rate in a tubular heat exchanger. Other tube sizes would, of course, require a correction for the diameter in the Reynolds and Nusselt group of the equation (from McAdams) given at the top of Table VI. Correlations for estimating film coefficients for various materials that might be processed by indirect heating may be found in the texts cited ⁽¹⁾, ⁽²⁾ and elsewhere in the literature.

For sizing pipe lines and pumping requirements, Figure 11 shows pressure drop vs. flow rate and pipe size for Aroclor 1248 at temperatures over 300°F. Above this temperature Aroclor 1248 flows freely like water.

A bibliography appears on page 32

MONS 079986

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TABLE IV
THERMODYNAMIC PROPERTIES OF ARACLOX 1240

T, Temperature °C	Enthalpy H ₂₉₈ kJ/mole	Ca (Heat Capacity) J/mole °C	Density g/cm ³	Vol./Mol. cm ³ /mole	Boiling Point °C	Atmospheric Pressure mm Hg
12	0.000	0.2695	91.6	12.22	147	150
10	2.162	0.2711	91.3	12.19	146	149
50	4.881	0.2727	90.9	12.13	145	148
60	7.618	0.2743	90.6	12.08	145	147
70	10.367	0.2759	90.2	12.03	144	146
80	13.114	0.2775	89.8	12.00	144	145
90	15.861	0.2791	89.5	11.96	142	142
100	18.608	0.2807	89.1	11.91	142	142
110	21.355	0.2823	88.8	11.87	142	142
120	24.102	0.2839	88.4	11.82	141	141
130	26.849	0.2855	88.1	11.77	140	140
140	29.596	0.2871	87.8	11.73	140	140
150	32.343	0.2887	87.4	11.69	139	139
160	35.090	0.2903	87.0	11.64	139	139
170	37.837	0.2919	86.6	11.59	138	138
180	40.584	0.2935	86.2	11.53	138	138
190	43.331	0.2951	85.9	11.47	137	137
200	46.078	0.2967	85.6	11.42	137	137
210	48.825	0.2983	85.2	11.36	136	136
220	51.572	0.2999	84.8	11.30	135	135
230	54.319	0.3014	84.4	11.24	134	134
240	57.066	0.3030	84.1	11.18	134	134
250	59.813	0.3046	83.7	11.13	134	134
260	62.560	0.3062	83.4	11.07	133	133
270	65.307	0.3078	83.1	11.01	133	133
280	68.054	0.3094	82.8	10.96	132	132
290	70.801	0.3110	82.5	10.90	132	132
300	73.548	0.3126	82.2	10.85	131	131
310	76.295	0.3142	81.9	10.80	131	131
320	79.042	0.3158	81.6	10.75	130	130
330	81.789	0.3174	81.2	10.69	129	129
340	84.536	0.3190	80.9	10.63	129	129
350	87.283	0.3206	80.6	10.57	128	128
360	90.030	0.3222	80.2	10.51	127	127
370	92.777	0.3238	79.8	10.45	127	127
380	95.524	0.3254	79.4	10.39	126	126
390	98.271	0.3270	79.1	10.33	125	125
400	101.018	0.3286	78.8	10.27	124	124
410	103.765	0.3302	78.5	10.21	124	124
420	106.512	0.3318	78.2	10.15	123	123
430	109.259	0.3334	77.9	10.09	123	123
440	112.006	0.3350	77.6	10.03	122	122
450	114.753	0.3366	77.2	9.97	121	121
460	117.500	0.3382	76.8	9.91	121	121
470	120.247	0.3398	76.4	9.85	120	120
480	122.994	0.3414	76.1	9.79	119	119
490	125.741	0.3430	75.7	9.73	118	118
500	128.488	0.3446	75.4	9.67	118	118
510	131.235	0.3462	75.0	9.61	117	117
520	133.982	0.3478	74.7	9.55	116	116
530	136.729	0.3494	74.4	9.49	115	115
540	139.476	0.3510	74.1	9.43	114	114
550	142.223	0.3526	73.7	9.37	113	113
560	144.970	0.3542	73.4	9.31	112	112
570	147.717	0.3558	73.0	9.25	111	111
580	150.464	0.3574	72.7	9.19	110	110
590	153.211	0.3590	72.4	9.13	109	109
600	155.958	0.3606	72.0	9.07	108	108
610	158.705	0.3622	71.7	9.01	107	107
620	161.452	0.3638	71.4	8.95	106	106
630	164.199	0.3654	71.0	8.89	105	105

MCNS 079567

FLOW RATES FOR AROCLOR 1248

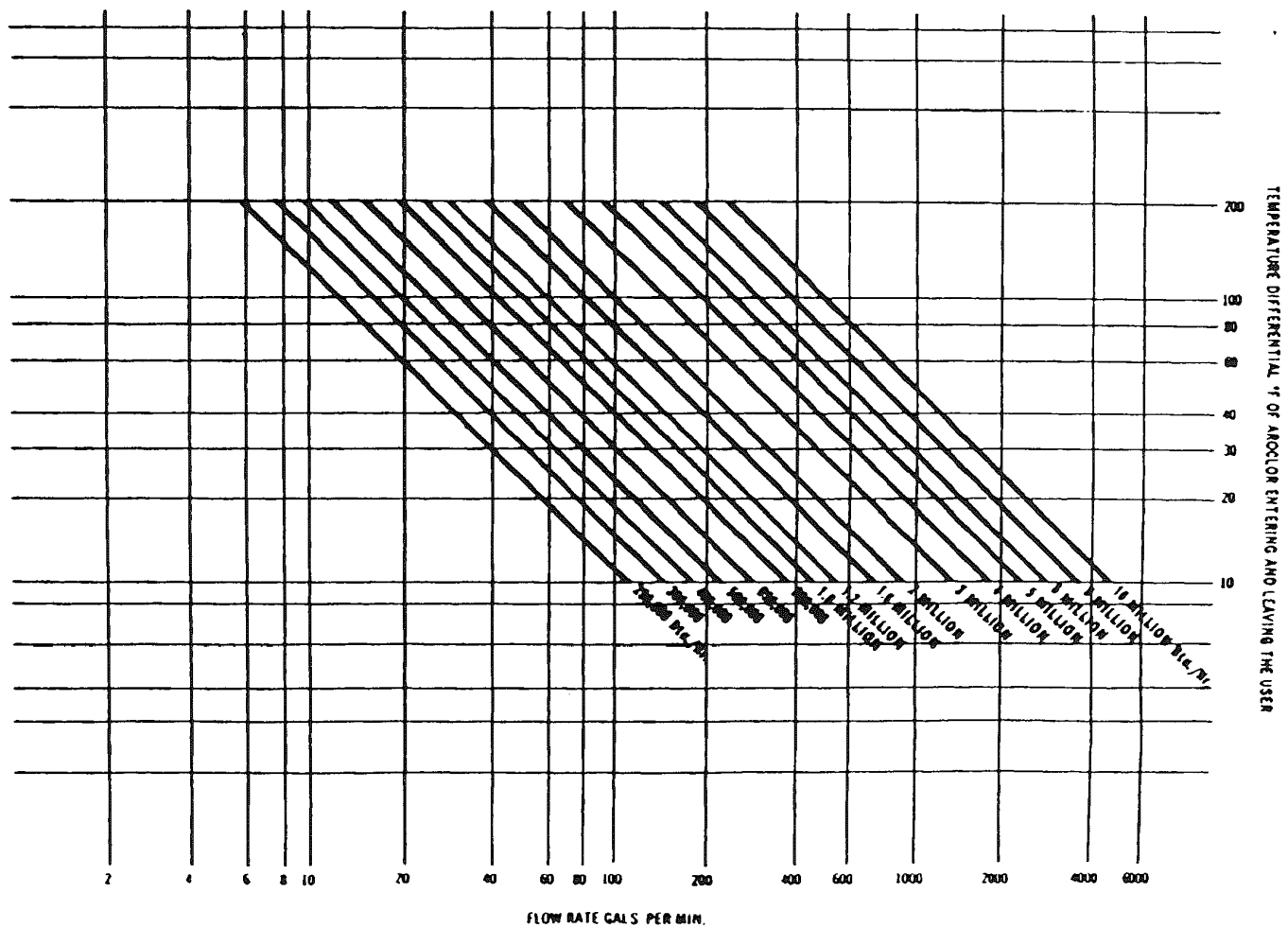


Figure 10

MUNS 075988

TABLE V
THERMODYNAMIC PROPERTIES OF AROCLOR 1248
PRANDTL

Temperature		Absolute Viscosity Lbs. /Sq. Ft.	Thermal Conductivity Btu. /Sq. Ft. °F.	C_p /lb.	$\left[\frac{C_p}{h}\right]^{0.4}$	Temperature		Absolute Viscosity Lbs. /Sq. Ft.	Thermal Conductivity Btu. /Sq. Ft. °F.	C_p /lb.	$\left[\frac{C_p}{h}\right]^{0.4}$
°F.	°C.					°F.	°C.				
32	0	.....	0.0577	.....	.....	320	160	3.53	.0542	20.6	3.35
40	4	.....	.0576	.....	.....	330	166	3.34	.0541	19.6	3.29
50	10	.....	0.575	.....	.....	340	171	3.14	.0540	18.5	3.22
60	16	2000	.0574	9044	39.5	350	177	2.95	.0539	17.5	3.15
70	21	500	.0573	4430	28.7	360	182	2.78	.0537	16.7	3.08
80	27	405	.0572	2353	22.3	370	188	2.66	.0536	16.1	3.04
90	32	278	.0570	1361	17.9	380	193	2.54	.0535	15.4	2.99
100	38	180	.0569	780	14.4	390	199	2.42	.0534	14.6	2.94
110	43	114	.0568	566	12.6	400	204	2.32	.0532	14.3	2.90
120	49	77.5	.0566	388	10.8	410	210	2.20	.0531	13.7	2.85
130	54	50.0	.0565	293	9.7	420	216	2.10	.0530	13.1	2.80
140	60	43.5	.0564	221	8.7	430	221	2.03	.0529	12.7	2.76
150	66	33.8	.0563	173	7.80	440	227	1.93	.0527	12.3	2.73
160	71	26.6	.0562	137	7.15	450	232	1.83	.0526	11.7	2.68
170	77	22.0	.0560	115	6.68	460	238	1.76	.0525	11.3	2.64
180	82	18.2	.0559	95	6.18	470	243	1.71	.0524	11.0	2.61
190	88	15.2	.0558	80	5.78	480	249	1.64	.0523	10.7	2.58
200	93	12.6	.0557	67	5.38	490	254	1.57	.0521	10.3	2.54
210	99	10.6	.0555	57	5.05	500	260	1.51	.0520	10.0	2.51
220	104	9.45	.0554	51.1	4.83	510	266	1.45	.0519	9.67	2.46
230	110	8.10	.0553	44.1	4.56	520	271	1.38	.0518	9.26	2.43
240	116	7.26	.0552	39.8	4.36	530	277	1.33	.0516	9.00	2.40
250	121	6.48	.0550	35.9	4.18	540	282	1.28	.0515	8.72	2.37
260	127	5.76	.0549	32.1	4.00	550	288	1.22	.0514	8.36	2.34
270	132	5.03	.0548	28.2	3.81	560	293	1.18	.0513	8.14	2.31
280	138	4.75	.0547	26.8	3.73	570	299	1.13	.0512	7.85	2.28
290	143	4.40	.0546	25.1	3.63	580	304	1.09	.0510	7.63	2.25
300	149	4.07	.0544	23.4	3.53	590	310	1.04	.0509	7.33	2.22
310	154	3.83	.0543	22.2	3.45	600	316	1.01	.0508	7.16	2.20

MUNS 079989

TABLE VI
HEAT TRANSFER DATA for AROCLOR 1248
FILM COEFFICIENTS

$$h = \left[\frac{12.1}{0.81} \right] \times 0.023 \left[\frac{D G}{\mu} \right]^{0.8} \left[\frac{C_p \mu}{h} \right]^{0.4} \quad (\text{Mc Adams})$$

Based on flow through 0.01" I. D. tube (1" O. D. x 12 ga.) expressed in Btu./sq. ft./hr./°F.

FLOW RATE, GPM.												
°F.	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
150	.....	.....	.....	.....	.....	83.2	88.2	93.8	103	114	123	130
200	.....	44.9	61.4	78.7	94.8	109	124	138	151	164	179	191
250	33.5	58.5	80.9	102	122	141	159	177	195	212	229	245
300	40.5	70.1	97	122	146	169	191	212	233	254	274	294
350	45.3	79.0	109	137	164	190	215	239	262	286	309	331
400	49.0	85.5	118	149	178	206	232	259	284	309	334	358
450	53.3	93	128	162	193	224	253	282	309	336	363	388
500	56.3	98	136	171	204	236	267	297	327	356	383	411
550	60.5	105	145	183	219	253	286	319	350	381	411	441
600	64.2	112	155	195	233	269	305	339	373	405	437	469

Calculations for other pipe sizes can be made using the data found in Tables IV and V.

No film coefficients were calculated for flow rates where the Reynolds number was less than 2100.

FRICITION LOSSES IN SYSTEM PIPING
 AROCLOR 1248, ABOVE 300°F.

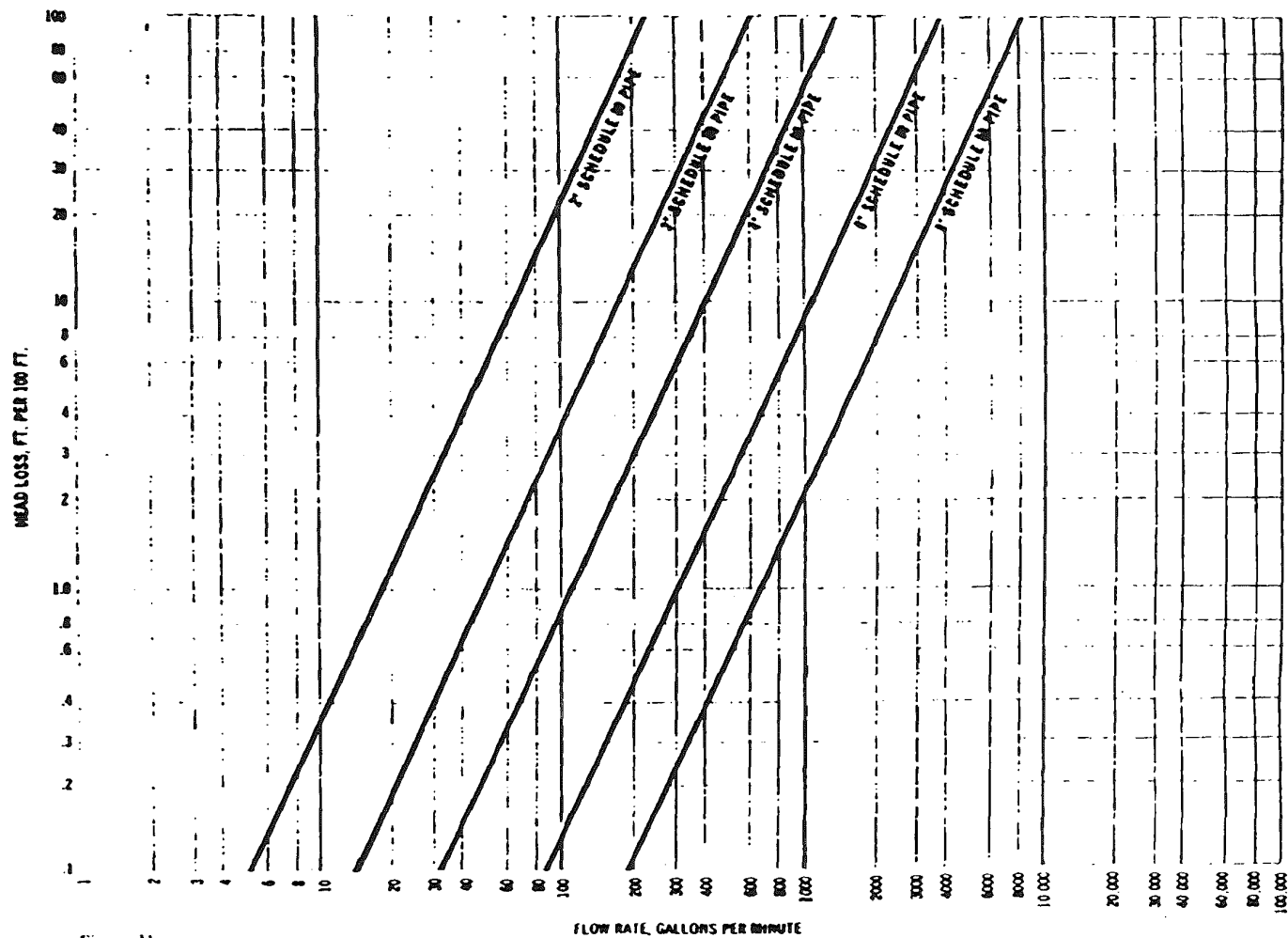
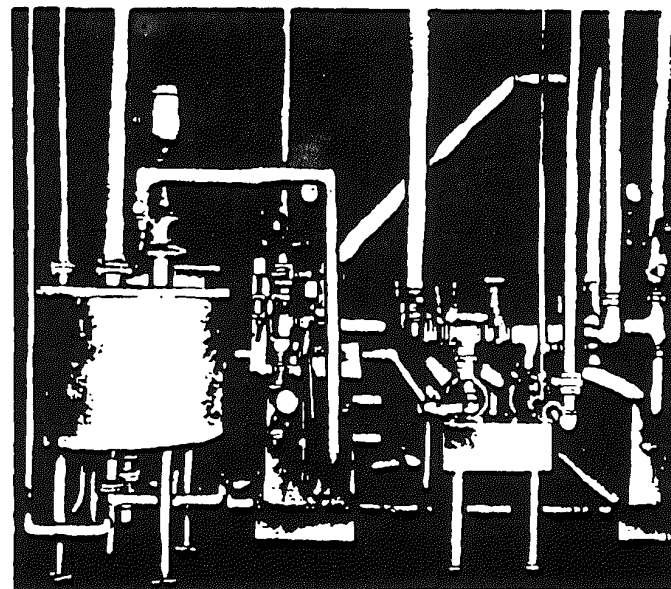


Figure 11

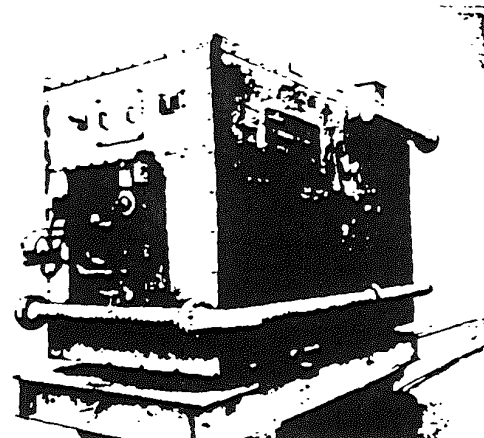
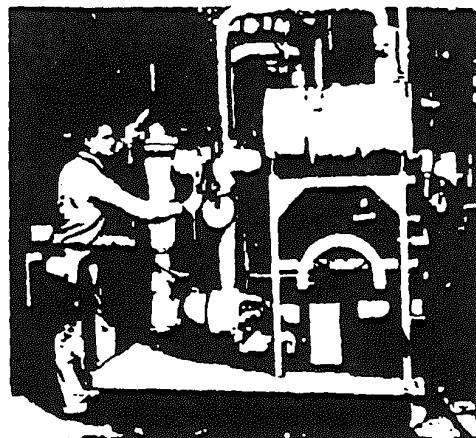
**TYPICAL
HEATERS
USING
AROCLOR
1248**



A 200,000 Btu. (right) and a 300,000 Btu. heater, both gas-fired, have been in use at Monsanto for over 14 years for organic chemical reactions. The heaters have operated near 600°F. with the same charge of Aroclor 1248 for periods of 7 years.

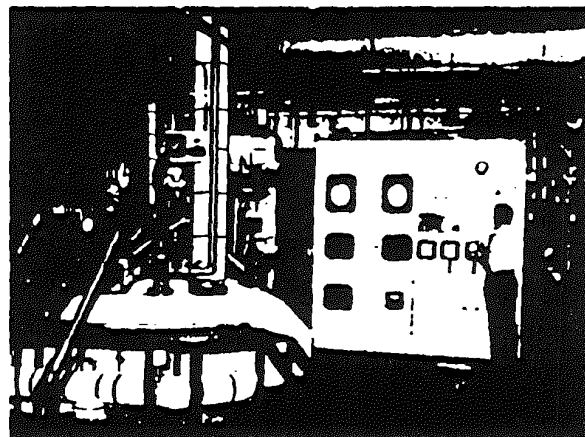
MUNS 075992

RIGHT
A 40,000 Btu. per hour electrically heated portable heat exchanger used to heat vessels of about 50 gallons working capacity. This unit was built for a variety of small scale chemical reactions. It was initially designed to vaporize approximately 200 lbs./hr. of an organic compound which has a heat of vaporization of 156 Btu. per pound; a 30% heat loss was allowed for. Experience with the heater indicates that a horizontal rather than the vertical mounting of the immersion heater (of operator's left) would have been more satisfactory.

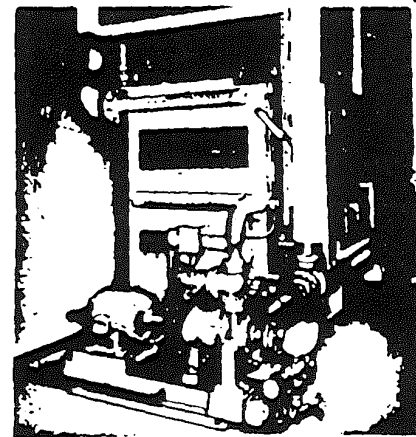


FAR RIGHT
A 4,000,000 Btu./hr. forced circulation International Lullmont heater.

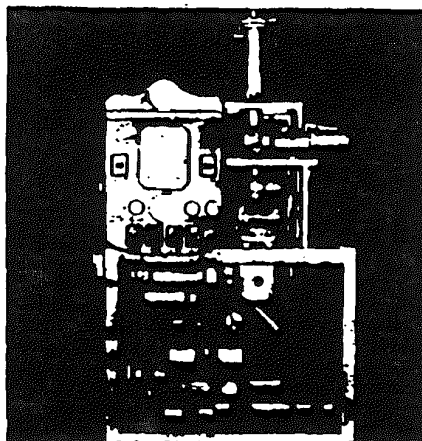
RIGHT
Control panel for a 3,000,000 Btu./hr. International Lullmont heater that operates the 3,500 gallon, glass-lined kettle shown on the left. This kettle is the largest of its kind in the United States.



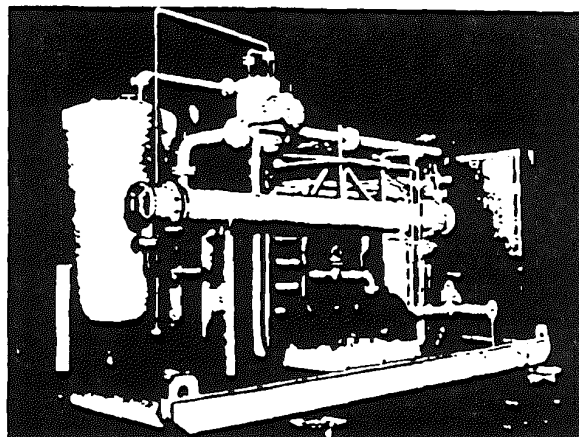
FAR RIGHT
Commercial heaters operating on Ancor 1248 are available in any capacity desired. This is a 1,700,000 Btu./hr. installation.



MUNS 079994



(Photo Courtesy Patterson Foundry and Machine Co.)



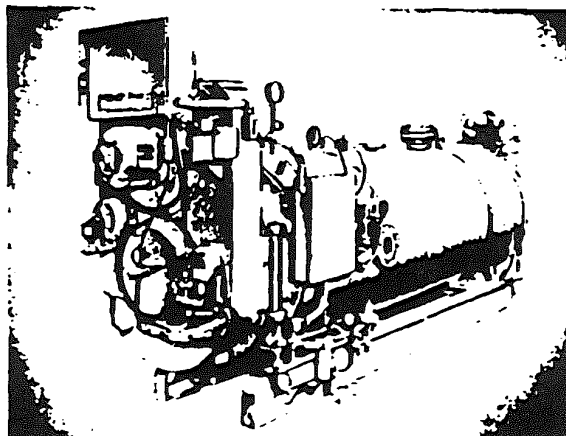
(Photo Courtesy Union Iron Works)

FAR LEFT

A pilot plant resin processing vessel operated on indirect heat transferred by Arco 1248. Vessel and heater are mounted together in one unit.

LEFT

This 500,000 Btu/hr. forced circulation heater is electrically heated and designed for a liquid temperature of 500°F. The construction is similar to a double pipe heat exchanger with the electric heating elements in the inner pipe, the Arco 1248 circulates through the annular space between inner and outer pipe. The liquid Arco 1248 is delivered from the heater at a temperature of 500°F and heats the contents of a jacketed kettle with a batch capacity of 1,000 gallons.



This design for a forced circulation heater was developed by Cleaver Brooks Company.

LITERATURE CITED

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2. Sullivan, M. V., Wolfe, J. K., and Zisman, W. A., "Indus. Eng. Chem.," 39, 1607 (1947).
3. Granet, I., "Heat Transfer Performance Curves", *Chemical Engineering*, P. 187-190, March, 1955.
4. McAdams, W. H., "Heat Transmission", McGraw-Hill Book Co., Inc., New York, (1942).
5. Kern, D. Q., "Process Heat Transfer", McGraw-Hill Book Co., Inc., New York, (1950).

aroclor

LIQUID HEAT TRANSFER MEDIUM

For temperatures up to 600°F.

Long-lasting, trouble-free service

Fire-resistant, non-corrosive

Operates in un-pressured, minimum cost
equipment

*Monsanto supplies Aroclor 1248, but not
the heat exchangers. Monsanto will be
happy to recommend sources of supply.*

MONS 075996

Monsanto

MONS 079997

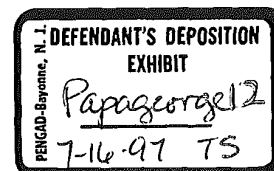
therminol: FR
SAFETY
OF HANDLING

On the basis of animal toxicity studies, THERMINOL FR may be considered only slightly toxic from the standpoint of accidental massive skin exposure or accidental ingestion. Similarly, single exposures to high concentrations of vapors (when heated sufficiently to volatilize) or high concentrations of decomposition products (if the fluid is accidentally discharged into the fire chamber) are not serious hazards because the irritating character of such concentrations preclude voluntary exposure.

Repeated or prolonged skin exposure should be avoided since THERMINOL FR acts as a solvent for fats and oils of the skin. Removal of these natural, protective barriers can lead to drying and chapping such as occurs with exposures to paint thinners. More important, THERMINOL FR may be absorbed if it is allowed to remain on the unbroken skin. For these reasons, we recommend that the skin be washed with soap and water if there is contact. A skin burn resulting from accidental contact with hot fluid should be treated in the normal manner for any thermal burn due to hot oils.

Because of its low vapor pressure, there is no significant vapor inhalation hazard when THERMINOL FR is at room temperature. For example, there is no vapor exposure problem while transferring the fluid from its shipping container to the heat transfer system. On the other hand, the vapors emitted by THERMINOL FR heated to elevated temperatures are injurious on prolonged exposure. It is indicated that the "threshold limit value" or atmospheric vapor concentration which cannot be safely exceeded (on a daily basis) is 0.5-1.0 milligrams of THERMINOL FR vapor per cubic meter of air in the workroom. In heat transfer installations, the fluid must be used in a closed system free from leaks with the expansion tank vented to the outdoors. Accordingly, there should be little or no opportunity for workers to come in contact with vapors.

MONS 076584



19. ISOCYANATES

Dr. Kelly will be visiting Bayer and will pass on any information he acquires. According to I.C.I., 1,5 naphthylene diisocyanate is a strong asthma producer.

20. SANTOCCEL AND SYTON

Early toxicity evaluations of Santocels with rats had given misleading results. It is now reasonably certain that Santocel does not cause silicosis in animals although it does cause some degree of fibrosis and irritation in the lungs. Du Pont now label their product "Caution - harmful dust" and M.C.C. use a similar phrase to the effect that the material should be handled with care and users should not expose themselves unnecessarily to the dust.

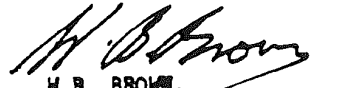
Although Syton does not produce silicosis, it has been shown that it tends to aggravate tuberculosis. Animals who have been given a sublethal dose of tuberculosis from which they would normally recover, die when subjected to doses of Syton spray.

Extensive sampling tests of the air of numerous U.S. factories using Syton, failed to detect the presence of Syton. In India the conditions in the factories are very favourable to the formation of Syton dust and the mills should be cautioned to take greater care in their processing and to supply their workers with masks.

21. AROCLORS 4465 AND 5460 IN AGRICULTURAL FORMULATIONS.

These Aroclors act as insecticide bonding agents on the leaf and increase the activity of the preparations. They are mostly chlorinated terphenyls and have greater toxicity than the lower members.

It is difficult to decide whether there is any hazard in using these compounds in greenhouse sprays as the conditions as to quantity sprayed and the size of the droplets is so indeterminate. Aerosol sprays giving fine droplets will have a long suspension time in the air.


W.B. BROWN

WBB/MEB
26.11.54.

MONS 095223

A Guide to Accumulation and Shipment of

WASTE ASKAREL FLUIDS

SAFE HANDLING OF ASKAREL FLUIDS

Improperly handled, Askarel fluids could be harmful to you and to your environment. Because of this, the following statement appears on all containers of Askarel fluid shipped by Monsanto. Please read this statement carefully:

old) "Askarel fluids contain Polychlorinated Biphenyls (PCBs). Care should be taken to prevent entry into the environment through spills, leakage, use, vaporization, or disposal of liquid or containers. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact, flush with water. In case of spillage onto clothing, the clothing should be removed as soon as practical, skin washed, and clothing laundered."

ACCUMULATION OF WASTE FLUIDS

Each time a fluid is transferred there is chance some will be spilled. Therefore, accumulate waste fluids in the same drums you will use for shipping to reduce this hazard.

DRUMS TO USE

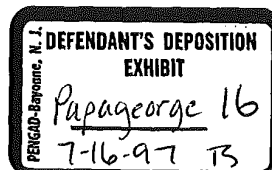
55-gallon drums: Must be 18-gauge steel or heavier and have a 2-bung head.

5-gallon drums: Must be 24-gauge steel or heavier.

(Drums must meet DOT 17-E specifications)

cont.

MONS 074772



DO NOT USE

Old drums
Rusted drums
Corroded drums
Damaged drums
Drums with weak walls or seams

LABEL DRUMS

Drums should be labeled "WASTE ASKAREL FLUIDS" and with the above "Safe Handling" statement or its equivalent.

FILLING DRUMS

Liquid Waste Only

Keep all solid materials out of drums used for waste Askarel liquid. Solid materials (sludge, rags, paper, sawdust, metal parts, floor sweeping chemicals, etc.) must be accumulated and disposed of separately. Contact your environmental department for proper disposal methods for solid materials.

Keep Water Out of Drums

Waste Askarel fluids shipped to Monsanto for incineration must not contain more than 1% water, or damage to the incinerator can result.

Do Not Overfill Drums

Airspace is needed to allow for possible thermal expansion of the fluid:

Minimum airspace: 55-gallon drums - 1- $\frac{1}{2}$ - 2 inches
5-gallon drums - 1 inch

Failure to leave sufficient airspace can result in possible fluid leakage or seam failure due to pressures caused by fluid expansion.

cont.

MONS 074773

Seal the Drums

Use a proper bung. Inspect the bung and the drum opening to insure tight, leak-proof seal.

Do not use damaged bungs, rags, pieces of wood, or other inappropriate materials to seal drums.

MOVING FILLED DRUMS

Use Proper Drum-Handling Equipment

Askarel-filled drums should be moved only with a proper drum-grabbing device. A parrot beak type of drum-grabbing device will reduce the possibility of damage to drums. A common drum handling device of this type is the Lift-O-Matic*, manufactured by Marvel Industries.

Pallets Not Recommended

Askarel-filled drums should not be palletized. However, if proper drum-handling equipment is not available and pallets must be used:

- Be sure pallets are properly constructed and undamaged to reduce the chance of the drum falling from the pallet when being moved.
- Steel-band all drums to their pallets.

Drums should be banded together horizontally as well as vertically to the pallet.

- So that four drums can be loaded across the width of a truck to prevent shifting in transit, multiple (2 or 4) drum pallets should be no more than 46 inches wide.

STORING FILLED DRUMS PRIOR TO SHIPMENT

- If Askarel-filled drums must be stored prior to return to Monsanto:

Inspect Drums For Leakage

Inspect drums for leakage around seams and bung, making sure all

*Trademark of Marvel Industries, Inc.

MONS 074774

seals are tight and leakproof.

Clean Up Spillage

Clean the outside of the drum of any spilled fluids, following approved cleaning methods. Properly dispose of materials and any water used to clean drums.

Store In Protected Area

Drums should be stored in an enclosed area where they will be protected from possible damage and inclement weather.

In Exposed Areas Store On Sides

If drums must be stored in an exposed area, store drums on their sides with both bungs below the fluid level so that rain water will not accumulate on the top of the drums. Otherwise, as drums "breathe", water can be drawn into the drum through the bung seal. Use blocks or other device to keep drums stationary.

Do Not Stack

Do not stack drums, whether stored on their sides or on end.

BEFORE SHIPMENT

Following this procedure For EACH Shipment to Monsanto:

1. Contact: Customer Services Supervisor
Attention: Mr. C. R. Field
Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166

(314) 694-3024

Give the following information:

- Number of drums in the shipment
- Name and address of person to receive drum labels
- Purchase order number, if a specific number is to be used
- Anything out of the ordinary about the fluid or the shipment

MONS 074775

You will then receive:

- Letter of authorization with Monsanto identification number for the shipment
- Pre-addressed shipment/warning labels for each drum
- Carrier's Advisory Note to be attached to the bill of lading
- Terms of shipment and charges, if any

Upon receipt of above materials:

2. Fill in EACH label with Monsanto identification number, product description and YOUR company name and telephone number.
3. Label EACH drum.
4. Put Monsanto identification number and your telephone number on Carrier's Advisory Note and attach to bill of lading.

LOADING AND SHIPMENT

- Perform a final check for leakage, damage, and to assure bungs are tightly sealed.
- Load and secure drums to prevent shifting in transit.
- If shipment is to be part of a mixed consignment, waste Askarel fluids are not to be shipped as mixed loads with raw materials for animal feed, food grade chemicals, foods, food packaging materials, or pharmaceuticals. Contamination of such goods may subject them to embargo or destruction.
- Be certain driver is aware of Carrier's Advisory Note and telephone numbers in case of leakage or other problems.
- Do not ship via piggyback.

Please note: Monsanto checks all shipments upon arrival. Failure to follow the above guidelines could result in fluids being returned to you and additional charges assessed.

The above instructions are intended only as a shorthand guide. For complete instructions refer to the ANSI CI07 document, "Guidelines for Handling and Disposal of Capacitor and Transformer Grade Askarels, Containing

Polychlorinated Biphenyls", available from the American
National Standards Institute, 1430 Broadway, New York,
New York 10018.

MONSANTO logo

MONS 074777

(F)

PRESENTATION TO FIELD SALES

PERSONAL AND CONFIDENTIAL

1. Introduction

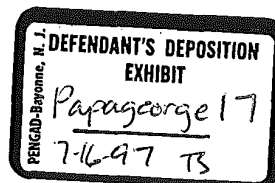
As most of you are aware, there have been several newspaper and magazine articles published in the U. S. in 1969 indicating that polychlorinated biphenyls (PCBs) have been discovered in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million or parts per billion category.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. As you know, Monsanto sells such products under the trade-names of Aroclor[®] 1254 and 1260.

2. Letter to Monsanto's Aroclor Customers

As a result of this publicity and because Monsanto's name has been mentioned in at least one of the articles, it was felt that Monsanto as a responsible member of the business community had a duty to alert its Aroclor customers to a potential problem of environmental contamination. In so alerting our customers, let me emphasize that this does NOT mean that we are agreeing with the contents of any

MONS 058519



published articles on PCBs, nor are we necessarily disagreeing with the articles. It does not mean that we accept that Aroclor 1254 and 1260 have caused any environmental problems. We are merely fulfilling what we consider to be our moral and our legal responsibility to our customers. When you consider the present public concern with pollution and the environment (witness Newsweek's recent article headlined "The Ravaged Environment"), I think you would agree that it would be foolish and imprudent to ignore the PCB articles. But let me repeat that notification to our customers does not imply guilt on the part of Monsanto.

Accordingly, a letter has been cleared by our Legal Department for mailing to each one of our direct Monsanto customers. This letter goes to Plasticizer customers only. A very similar letter will be mailed by the Functional Fluids Group to their customers. The letters will be mailed from St. Louis about the end of February. It will be addressed to:

Office of the President
XYZ Company
Accounts Receivable Address

MONS 058520

The Plasticizer letter will be signed by W. E. Schalk. A copy of this letter, together with a cover letter, will be mailed to the head office of each of our Aroclor distributors. The cover letter will indicate the action Monsanto is taking with regard to its direct Aroclor customers. We will recommend that our distributors mail a similar letter promptly to each of their Aroclor customers. Copies of our letter will be made available to our distributors in quantities sufficient to meet their needs. It is not our responsibility to alert our distributors' customers. To explain the action to our distributors we have visited the head offices of Central Solvents and American Mineral Spirits.

Let me summarize what Monsanto's letter says:

- 1) Its primary function is to alert customers to a potential environmental pollution problem. Con-fidentially, our Legal Department believes this will minimize and, hopefully, eliminate claims made against us for environmental pollution damage.
- 2) It does not imply guilt by Monsanto. At this time,

MONS 058521

we are taking a neutral stand on the controversy. There are real problems of analytical identification of PCBs, how accurate the levels observed are, how PCBs affect marine, aquatic and wildlife environments over the long-term. We have active programs in all these areas to better define the problem but a lot of work needs to be done before definite scientific conclusions can be drawn.

- 3) It points out that not all Aroclors are PCBs. This is an important distinction. Don't call the PCB problem the Aroclor problem. We sell Aroclors such as 5060, 5442 and 5460 which are NOT PCBs. They, therefore, should not be regarded as potential environmental contaminants.
- 4) Furthermore, it says that not all PCBs appear to be potential contaminants. Aroclors 1221, 1232, 1242 and 1248 have NOT been found in the environment. Neither have Aroclors 1262 and 1268. We can only theorize as to why this should be. At this stage, we prefer not to indulge in theories. The salient

MONS 058522

point is that since they have not been found - in spite of intensive investigations by scientists both here and abroad - indicates that they are not persistent contaminants and, therefore, do not pose a long-term threat to the environment.

- 5) By including a copy of the Federal Water Pollution Standards established for all states of the Union, we are pointing out that care will be needed in preventing environmental contamination from other raw materials and products not just Aroclor 1254 and 1260. We feel this Chemical Week reprint will be useful information for many of our smaller customers.

3. Customer Reaction

We expect this letter will lead to customer reaction. Our competitors are sure to learn of it and some of them may even be kind enough to capitalize on it or at least try to.

We can't anticipate all the ways in which our customers

MONS 058523

react. Remember this letter is going to the "Office of the President" so it may get down to his subordinates in a variety of different ways leading to a variety of reactions. Why send it to the Office of the President? Because our Legal Department feels in this way we have really notified a company officially of the potential problem. If there is any legal litigation later, the courts might feel that sending the letter to Joe Doe, Plant Purchasing Agent, was not legal notification because Joe Doe may not be an officer of the company.

So we must be prepared to expect hearing from customer employees we've never met nor heard of before. They may call anyone in the district office, many are likely to call Mr. Schalk, some may call executives all over the St. Louis campus.

Let us concern ourselves with what happens when a customer calls your regional offices about the letter or raises the matter during a sales call. For your guidances, we've prepared some aids:

MONS 058524

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-7-

- (1) A list of DOs and DON'Ts for Regional Managers.
- (2) A list of "likely" customer questions together with answers approved by Jim Springgate and our Legal Department.

MONS 058525

Decreased Sales

Beware of decreased sales to any account after the letter is sent out. If you suspect this, your plan of attack could be:

Monsanto: "I see your purchases of Aroclor XYZ are down. I hope it doesn't mean your business is having a tough spell".

Customer: "No, business is O.K. but it's that so-and-so letter you sent".

Monsanto: "Does this mean you've switched to a replacement for XYZ?"

Customer: "Yes".

Monsanto: Probe to find what it is. Is it inferior to Aroclor. Is it really not a contaminant too. Point out our range of products. Use Monsanto bulletins/Blue Book to get him to evaluate one of our products.

OR

Customer: "No but I'm living off inventory till my boss can get a replacement".

MONS 058526

Monsanto:

"Let me help you with some suggestions if I can. In the Blue Book here, we cover over eighty possible products---".

Competition:

Remember that Aroclor[®] plasticizers are outstanding products. They are inert, oxidatively and chemically stable, give good adhesion in adhesives, sealants and coatings, moisture resistant, give low vapor transmission in coatings. In other words, they are used because of PERFORMANCE. Competitors will suggest chlorinated paraffins but they are not so good. Every salesman who has gone through the Training School in the past year - and over 90% have - have been given the advantages of Aroclor over chlorinated paraffins. Use it if you have to. You might ask the customer: "How sure are you that chlorinated paraffins are not environmental contaminants. What proof do you have". Blunt the competitive attacks by getting them to be defensive.

MONS 058527

If the customer is going to evaluate replacements, make sure he gets samples of plenty of our standard plasticizers.

Future:

There may be some panicky reaction to start with. Your job will be to calm it down. To do that, you have to be confident. Our Aroclor sales have increased every year for ten years - in boom or recession. We want 1970 to be no different. Let's not enter a new decade with a down-turn.

MONS 058528

COPY

DATE June 17, 1979

JOB

HEAD: How To Keep Your Therminol FR System Leak-Free

COPY: Your Therminol FR heat transfer system is a closed system. Thus fluid leakage is easily controlled. Here are some suggestions that will help you control leaks and dispose of any fluid taken out of your system.

Check These Sources For Leakage

Generally, there are four sources of leaks in a system:

Fittings. Weld all connections. Flange fittings where accessibility is desired.

Pump Seals. Canned pumps are the best protection against leakage. If mechanical seals are used, enclose them or provide a drip pan with a drain to a collection sump.

User Seals. Direct all drains to a collection sump. Install drip pans at rotary joints.

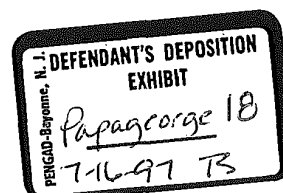
Expansion

Tank Vent. Direct vent to either a cold seal tank, catch pot or drum to contain vapor condensation and light ends.

When your system is under design or construction, specify check valves at selected points. This will minimize fluid discharge in the rare case of a rupture at the using equipment or in the heater coil.

MONS 080871

Monsanto



COPY

DATE Jan 18, 1970

JOB

HEAD: How To Dispose Of Therminol FR

COPY: If leakage does occur, collect the fluid and place it
in drums.

Return material for disposal to:

Monsanto

W. G. Krummrich Plant

Saget, Illinois

Attn: Supervisor, Department 246

Please advise your Monsanto fluid specialist that
material is being returned for disposal so the proper
papers can be prepared. The charge for this disposal
is \$.03/lb. (not including drums and freight costs).

Follow the same procedure for change-out of your fluid
charge. Or, you may wish to reclaim this fluid under
our regular policy.

Your investment in a heating system using Therminol FR
fire-resistant fluid shows you care about safety; safety
for personnel and equipment. The above suggestions
are made to help you keep your system leak-free and pro-
tect this valuable investment.

If you have any questions about fluid leakage, disposal
or reclamation, please contact your Monsanto fluid
specialist.

MONS 080872

W. B. PAPAGEORGE - ST. LOUIS

JULY 13, 1970

H. S. BERGEN
J. R. FALLON
D. A. OLSON
D. E. ROUSH

W. G. CANHAM - P4-W301

You are probably aware of our concern regarding the contamination of the environment with polychlorinated biphenyls (Monsanto's Aroclors).

Monsanto's Therminols (FR Series) contain Aroclors. In order to stay in this business, we are insisting that heat transfer systems be designed to assure minimum loss by leakage or vaporization.

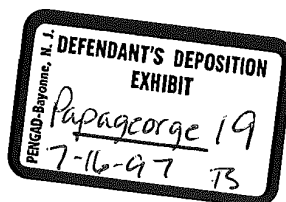
I am interested in reviewing Monsanto's system design and comparing it with the design we propose to our customers. Will your office please send me a copy of P2.1 Std. 19 "Selection Guide - Piping for Heat Transfer Fluids", as well as any other information available.

W. B. PAPAGEORGE

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MONS 098181

123



W. B. PAPAGEORGE - ST. LOUIS

JULY 13, 1970

H. S. BERGEN
G. L. BRATSCH - WOK
F. J. HOLZAPFEL
J. R. SAVAGE

B. W. CORLEW - WOK

Our PCB pollution control discussions last Friday were, for me, very informative. I was impressed with the interest and concern expressed by your plant personnel.

Steps to control escape of Aroclors to the environment have been successful as demonstrated by decreasing amounts detected in your effluent. Progress on completion of the catch basin is dramatic.

I was, however, disappointed that those areas which could experience spillage, leakage, etc. to a high degree are not as yet tied to the new catch basin. Specifically, I am referring to the drumming station, tank car and tank truck loading spots, the storage tank area, the residue handling area and the trash collecting bin. The few trenches I noted in some of the areas are not tied in to any collection system. Most of the surface is covered with crushed limestone, some of which is covered with Aroclor. There is no control of surface drainage through the outdoor areas.

I recommend that these areas be paved, curbed and drained through your new catch basin or possibly a second basin if the drainage system layout requires it.

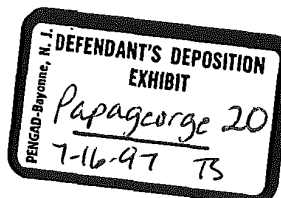
I encourage your interest in controlling atmospheric emissions and recommend you accelerate your efforts in completing your emission audit. Consideration should be given to the use of condensers, entrainment separators, drowning jets and interconnection of vents to provide for transfer of vapor from vessel to vessel rather than free exhaust to the atmosphere.

With the interest I noted among your people, I am confident that you will succeed in preventing the escape of Aroclors to the environment to the extremely low levels required. If I can help, let me know.

MONS 098182

W. B. PAPAGEORGE

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W. B. PAPAGEORGE - ST. LOUIS

AUGUST 17, 1970

H. S. BERGEN
P. B. HODGES
F. J. HOLZAPFEL
J. R. SAVAGE

G. L. JESSEE - ANNISTON

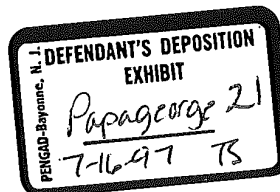
The PCB review and the inspection of the Aroclor facilities on July 31 were to me very informative and I hope your plant personnel benefited also. Progress on carbon adsorption studies, the interceptor basin, analytical capabilities and reduction of PCB in the plant effluent are very encouraging.

I was, however, disappointed that we are still using considerable quantities of sand to keep the floors in the department partially dry. This long standing practice creates sand disposal problems as well as a difficult floor scraping and cleaning problem. Our efforts should be directed at preventing Aroclor from getting on the floor. Spills and leaks should be under extremely tight control so that the department has a "bone dry" appearance. If leaks do occur, they should be very rare and some evidence of containment such as sand, a bucket, or oil absorbant should be visible. These should be considered as temporary measures until permanent correction is made and should not be tolerated for long periods. I recognize that this poses a very challenging objective, but it can be achieved as demonstrated by both the Newport and Sanget operations. I believe it would help psychologically if the sand boxes at the base of all stairs were removed.

The interceptor basin being installed will remove the Aroclor from water streams originating in the chlorination and distillation areas.

I have concerns regarding the containment of Aroclors from the bulk storage, drumming, tank car and tank truck loading areas. The crushed rock areas should be replaced with concrete pavement, curbing and drainage to the interceptor basin. The amount of Aroclor on the drumming area floor appeared excessive and could overload the small sump which is in the present drainage channel from this area.

MONS 098174



-2-

We should strive for an operation in which no Areclor
is visible and one that we would not hesitate showing
to a severe critic such as Congressman Ryan.

W. B. PAPAGEORGE

MONS 098175

Monsanto

FROM (NAME & LOCATION)

W. B. PAPAGEORGE - ST. LOUIS



January 8, 1971

cc

H. S. Bergen
J. Mason

SUBJECT

PCB ENVIRONMENTAL PROBLEM
DECEMBER STATUS REPORT

REFERENCE

TO

P.J.A. Marsh - BRUSSELS
W. S. Clark
J. R. Durland- TOKYO
M. W. Farrar - 2nd Street
E. V. John
R. E. Keller - 2nd Street
R. M. Kountz
T. L. Gossage
P. S. Park
W. R. Richard
J. R. Savage
E. P. Wheeler

MARKETING:

Efforts continue to educate Therminol FR users to control leakage.

Consulting visits to JFQ and W GK plants have brought results - all but one system at JFQ converted from Therminol FR/Aroclor to Therminol 66.

At W GK, two systems converted and four in process of converting from Therminol FR/Aroclor fluid to Therminol 66.

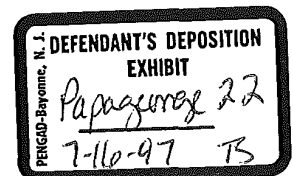
A U.S. Dept. of Agriculture press release announcing the banning of both polychlorinated biphenyls and polychlorinated terphenyls in pesticide formulations has generated a considerable number of inquiries from our chlorinated terphenyl customers. Inquiries made to representatives of the U.S.D.A. to establish reasons for including terphenyls have been answered with vague generalities. Formal protest is being prepared and will be forwarded.

ENGINEERING:

Liquid Incineration - Krummrich - CEA 2415.

Final drawings of the incinerator system from John Zink Company were received as well as their fabrication schedule. All additional equipment is on order and design is proceeding on schedule.

MONS 099633



MCS 1016 - Krummrich - CEA 2417

Additional evaluations with Manufacturing led to a decision to revise the scope of this project. The revised Data Transmittal is now scheduled for mid-January. Definitive design continued on elements not effected and pile driving work for foundations was started.

Tributyl Phosphate - Queeny - CEA 2371

Pre-approval funds were provided to start definitive design and work is in progress.

N-C Phosphate - Queeny - CEA 2451

The preliminary project scope was developed, a safety review was held and the scope was reviewed with Research and Manufacturing. A capital estimate is in progress and the Appropriation Request Data Transmittal will be issued in mid-January.

Solids Waste Disposal - Krummrich - CEA 8042

Analysis on the samples collected during the Enviro-Chem test are still in progress. Meanwhile, a system specification was developed for facilities to remove PCB's from solid waste. Work continued with marketing in an attempt to better establish what we can expect for disposal from our customers.

JAPAN:

No new developments reported.

EUROPE:

No new developments reported.

MEDICAL:

The 18 month status reports on the two-year chronic dog studies with Aroclors 1242, 1254 and 1260 were received. There has been essentially no change in the animals since the 12 month reports last July.

The teratology studies with these same compounds have been scheduled and will be underway shortly.

MONS 099634

PUBLIC RELATIONS:

Three new sources of PCB news appeared during the month. The American Chemical Society syndicated an article, based on Carl G. Gustafson's article in Environmental Science and Technology. The ACS feature appeared mainly in East Coast and New England weeklies. The College Press Service distributed a PCB story to campus newspapers which rounded up previously published material. So far, it has appeared in the Washington University and SIU student dailies. A third article, quoting oceanographers meeting in Rome, criticized Monsanto for refusing to release production figures on PCB.

RESEARCH:

Carbonless Reproduction Paper Solvents

Process assistance was provided Dixie Chemical Co. during initial phases of MIPB-2 production. Operations proceeded well and satisfactory crude reaction product was made which was further refined in the J. F. Queeny Plant.

A process modification proposed by Dixie was shown to be satisfactory regarding performance of MIPB-2 in dye color development.

As a result of an exchange of visits between Nashua and Monsanto, two candidates appear promising as Aroclor 1242 replacements:

XS-276 (HB-40/Aroclor 5442) and XS-310 (MIBP/chlorinated paraffin). XS-276 has received a partial plant trial and a drum of XS-310 has been ordered for more testing. Other coded samples are also under test at Nashua.

G. E. Samples

A second set of plant and stream water samples from G.E.-Pittsfield, Mass. were analyzed for PCB's. The results (≤ 1 ppm) were similar to the first set analyzed in early December. Additional samples of milk have been received from G.E. for PCB analysis.

J. F. Queeny

The monthly monitoring of the JFQ Plant composite effluent continues. The PCB level found for November was 19 ppb calculated as Aroclor 1248. This level is lower than found for September and October by a factor of about 4X, part of which can be attributed to the current very low laboratory blanks.

MONS 099635

Solid Disposal - Pyrolysis Unit

The analysis of all samples taken during the recent Enviro-Chem PCB solid waste disposal tests have been completed and the results reported for correlation with engineering data. A second sampling of the pond associated with the Enviro-Chem incinerator demonstrated that the PCB disposal tests did not contaminate the site (<10 ppb).

Aroclor 5442 Composition

GC/Mass analysis of a composite sample of materials extracted by water from eleven current Aroclor 5442 lots has been completed. No highly toxic components, furans, dioxins, etc., were identified which could account for the reported higher toxicity of Aroclor 5442 to Daphnia over chlorinated biphenyls. Chlorinated biphenyls and terphenyls were identified as the major constituents of the composite. Previous work had shown that an impurity in Aroclor 5442 gave a low-resolution mass spectrum similar to the spectrum of tetrachlorodibenzofuran. It was later found that tetrachloromethylbiphenyl has a similar mass spectrum.

To determine which of these compounds is present, a high resolution mass spectrum was obtained at the Physical Science Center on a concentrate containing the impurity. This spectrum indicated the empirical formula of the impurity to be $C_{10}H_{12}O_2Cl_4$. The empirical formulae of tetrachlorodibenzofuran and tetrachloromethylbiphenyl are $C_{12}H_3OCl_4$ and $C_{13}H_8Cl_4$, respectively. No reasonable structure has been found for the indicated empirical formula. Another sample has been concentrated and is scheduled for high resolution mass spectrometry to verify the empirical formula of the impurity.

Biodegradation Testing

The expansion of the semi-continuous activated sludge (SCAS) testing facilities from 16 to 26 units was completed. This will allow us to study 24 products, including 10 new ones. Additionally, early in January a fractional replicate of a factorial experiment will be initiated. This preliminary experimental design will be used to determine the effect that seven variables have on the observed SCAS disappearance rates of three model compounds. The model compounds to be studied during the eight week duration of the test are biphenyl (degradable), 2,4'-dichlorobiphenyl (intermediate degradable), and 2,2', 4,4', 6,6'-hexachlorobiphenyl (non-degradable).

MONS 099636

A staggered schedule for all SCAS units has also been laid out which will allow one-third of the 24 units devoted to degradation to be sampled and analyzed (20 data points) during each month of operation. The compounds to be studied during January include TCB, MIPB, HB-40, 2,2'-dichlorodiphenyl ether and Aroclor 1221 as well as the three units devoted to the statistical experiment. The other compounds being fed (but not sampled and analyzed) to the remaining units are MCS 1043, MCS 1016, Aroclor 1242, Aroclor 1254, Aroclor 1232, ONCB, PNCB, p-chloroaniline, nitrated orthene, S-711M, hexabromobiphenyl, Aroclor 5432, Aroclor 5442, Aroclor 5460, and Aroclor 5465. Analysis and sampling of these units will begin in February and March. In the meantime, the effects that these materials have on the normal characteristics (pH, growth rate, and settling time) of the activated sludge will be monitored on a daily basis.

The two remaining units are being used to maintain special cultures, a C₂ biphenyl culture from MCL, and a biphenyl culture grown in our laboratories. Very rapid growth on biphenyl as the sole carbon source has been observed with the MCL-C₂ culture.

River Die-Away

River die-away tests with Aroclor 1242, Aroclor 1254, MCS 1016, MCS 1043, Aroclor 1232 and TCB at the 100 ppb level were discontinued after several weeks. The highly scattered data obtained indicated that the 100 ppb level was too low to achieve meaningful disappearance rates due to procedural problems and/or losses by non-degradation routes (volatilization, adsorption, etc.). Further experimentation is planned during the first quarter.

HB-40 and MIPB Biodegradation

A brief sampling period of the HB-40 and MIPB semi-continuous activated sludge (SCAS) units was completed 11/28/70. UV analysis of the hexane extracts gave mean disappearance rates of 58%/cycle for MIPB and 44%/cycle for HB-40 based on the total material present. A 3X cycle gave disappearance rates of 66% and 55% respectively while a 5X cycle gave 77% and 62% respectively. SCAS work with these materials will be concluded with an extended sampling period in January.

MONS 099637

River die-away tests on HB-40 and MIPB are nearing completion. After a three week exposure at the 1 ppm level to the normal level of micro-organisms in Meramec river water the MIPB concentration has decreased by a total of 85% of which 54% can be attributed to microbial degradation. Similarly for HB-40, the total concentration has decreased by 66% of which 57% can be attributed to microbial degradation.

Aroclor 1221

Feeding of the Aroclor 1221 SCAS unit continues but with only limited sampling of the unit. No quantitative data is available yet but qualitatively there appears to be a rapid disappearance of the lower homologs with a build-up of the higher ones. This unit is scheduled to be sampled for an extended period in January.

Aroclor 5432 Liquid-Liquid Chromatographic Analysis

The liquid-liquid chromatography method for the analysis of SCAS samples containing Aroclor 5432 has been optimized. The liquid-liquid system consists of a 3 ft. column packed with Zysan Permaphaze as the stationary phase and water/methanol (75%/25%, v/v) as the mobile phase. The ultraviolet detector response is linear between 0 and 50 µg of Aroclor 5432, absolute, with a lower detection limit of about 1 µg absolute. Analysis time is 40 minutes. Optimization of the system to other halogenated terphenyls will be made.

Carbon Adsorption Studies

The pilot unit continues to operate with minimum difficulties at an average flow rate of 6 gpm/ft². Effluent quality, at the present flow rate, is <10 ppb Aroclor for average influent concentrations in the range 100-2000 ppb and for occasionally high concentrations of up to 11,000 ppb. There has been no indication of a breakthrough. Present plans are to operate the unit until 12/30 at the present flow. If there is no indication of a breakthrough at that time, all data will be compiled for an evaluation and recommendation by a Pittsburgh carbon consultant.

MONS 099638

Filtration Studies

The study conducted to remove the Aroclor containing solids from the effluent of the new neutralization pit by filtration through a sand bed has been completed. At flows greater 200 cc/min the filter tended to blind with the fine solids. The solids could not be success-

fully washed from the filter. A report will be issued by 12/28 on all the filtration studies.

Solids-Aroclor Removal by Flocculation and Flotation

The clarifier unit from Biodize has been received. Plans are now being made for some necessary alterations on the unit. The complete installation is scheduled to be completed by 1/29/70.

Denver Equipment has completed their study on the removal of solids by flocculation and flotation. The most satisfactory flocculation results from these studies were obtained by conditioning with (200 ppm) CAO, and (10 ppb) $Al_2(SO_4)_3$ to preflocculate the solids and then intensifying the floc with (4 ppm) Separan MGL. Initial solids concentrations in the range (100-1000 ppm) were reduced to 19 ppm in a 120 min. settling time.

Flotation of the same material using 56 ppm of Armac T and 30 ppm of Aerofroth 65 produced a final effluent of 34.5 ppm of solids. Solids removal is more dramatic by flocculation, however, the froth may be more effective in removing the organics.

Betz is scheduled to complete their evaluation and recommendation by 12/21 on the floc study.

A tentative work plan will be issued by 1/4/71.

Pydraul Reformulations

Pydraul 312A

The new Pydraul 312A was formulated using 750 SUS mineral oil with Santicizer 711 as solubilizing agent. Production quantities will be sent to GM Central Foundry in January.

Pydraul 540B

We added 2.5% tributyl phosphate to minimize pump wear in oil gear equipment. We expect satisfactory performance.

Pydraul 135A and Pydraul 230A

We will use 750 SUS petroleum oil plus small amounts of TCB for improved fire resistance in these new formulations. Pump tests were satisfactory.

Pydraul A200B

The V-1050 Vickers pump test had excellent wear characteristics. A Tentative Process was issued.

MONS 099639

Pydraul 150A

We do not have a satisfactory candidate. Fire resistance is insufficient.

MANUFACTURING:

W. G. Krummrich Plant

PCB Levels in Sewer

1. Aroclor losses from the Aroclor Department averaged about 0.6 lbs/day and ranged from about 0.2 to 1.4 lbs/day.

Losses from the Sauget Village Treatment Plant for the period 11/17 - 12/17 averaged 34 lbs/day (177 ppb). Range for 7 samples was 9 to 53 lbs/day (47-280 ppb). Samples taken during the 3-day neutralization test (12/15 - 12/17) are not included. Average for this period was 27 lbs/day.

2. Program to monitor the various plant sewers was begun the last week of December. Plans are to composite samples twice per week for analysis.
3. Sewer samples were taken from the effluents of the other industrial plants. These included;

Midwest Rubber	9 ppb
American Zinc	6 "
Cerro Copper & Brass	9 "
Mobil Oil	54 "
Dead Creek	18 "
Village	2110 "

The only significant quantity is the PCB's from the Village sewer. This amounts to about 2 to 3 lbs/day. Probable source is Aroclor trailer washes at Rogers Terminal.

Projects To Reduce Sewered PCB's From Aroclor Dept.

1. Design package for project to pave and trench loading areas is 95% complete and will be issued by 1/15/71.

Program To Eliminate Sewered PCB's From Using Depts.

The Plant manager has requested by memo that all General Superintendents proceed at once to change out all Therminol FR units to non-Aroclor heat transfer fluids.

MONS 099640

Removal Of Soluble PCB's From Sewer Stream (Reach 10 ppb)

A 3-day test was run 12/15 - 12/17 in which the entire plant effluent was neutralized with lime. Results indicated no change in the average level of PCB's in either the influent or the effluent at the treatment plant at the 90% confidence level.

At this point, it appears possible to reach the goal of 10 ppb without secondary or tertiary treatment by doing the following:

1. Change out of all plant Therminol FR units to non-Aroclor fluids.
2. Continue control of losses at the Aroclor Department at less than 1.5 lbs/day
3. Clean all contaminated sewers and sewer boxes.
4. Monitor and control Rogers Terminal.

PCB Levels in the Atmosphere

A project premise and estimate for \$6,000 were prepared to replace the nitrogen purge with a nitrogen blanket at the mix tanks and to re-route the chlorinator rupture disc lines to the pad.

A sampling station will be shared with the Chlorine Department to monitor PCB content of air downwind from the Aroclor Department. Samples will be taken every other week starting the week of 1/11/71.

PCB Rework Project (Estimate 2095)

Project package is essentially complete and will be issued the week of 1/4/71.

Replacement Products (CEA 2417)

Ground was broken for the fractionator project for production of MCS 1016, replacement for Aroclor 1242 in capacitors.

Newport Plant (October/November)

Removal of Suspended Aroclor From Plant Effluent

Now that all jobs have been completed, a careful check was carried out to correlate PCB content at the interceptors compared with the final effluent discharge tank.

MONS 099641

At the interceptor, the PCB content was 22.6 parts per billion. Simultaneous sampling at the main effluent plant gave 54.0 parts per billion.

Difference of 31.4 parts per billion is arising from spillages from internal heat transfer fluid systems, and from drum leakages from Aroclor stored on drum flats. Evaluation is now in progress to change all internal Aroclor heat transfer fluid systems to Santotherm 66. The two areas involved are Santolube 900 and 4-NDPA. The expansion project for 4-NDPA has been requested to use a Santotherm 66 system.

Incineration

Contact has been made with Dr. J. B. Lewis, Chemical Engineering Division, A.E.R.E., Harwell, and Mr. Higginson who is in Division Engineering Design and Development, Refuse Disposal Branch of the Public Engineering Dept., Greater London Council.

Dr. Lewis is considering offering an incineration service to industry for the disposal of highly toxic wastes. Vodden and Macdonald are scheduled to meet with Dr. Lewis in the near future.

Mr. A. E. Higginson is very much in favor of industrial waste disposal services carrying highly toxic wastes for incineration through special systems provided by the Greater London Council. This appears to be a logical step forward and should be of significant advantage to our customer disposal problems. We intend to follow up with Mr. Higginson following our discussions with Dr. Lewis.

Atmospheric Emission

This investigation is proceeding and T.S.D. should assemble data in progress report issue.

Estuarial Dilution

The Monsanto effluent discharge of approximately 1.4 million gallons per day is further diluted in the Severn Estuary by the several rivers discharging into this area. Average daily flow for these rivers have been obtained and are as follows:

MONS 099642

River Usk.	535	million	gallons	per	day
River Wye	1319	"	"	"	"
River Severn	1178	"	"	"	"
River Stour	38	"	"	"	"
Bristol Avon	353	"	"	"	"
Somerset Minor discharges	45	"	"	"	"

The average daily flow corresponds to 3,670 million gallons per day.

The lowest dry weather flow for all these discharges has been established at 445 million gallons per day.

These volumes should be looked at in relation to the current discharges from the Newport location.

Used Drum Disposal

Blagden's drum reconditioning plant at Barking, Essex is acceptable for reconditioning used Aroclor drums as a customer service, but is not approved for the incineration and disposal of the washings, and this problem is being further investigated.

Anniston Plant

Current Level - Aroclor Wastes

Aroclor losses during Dec. averaged 1.5 lbs/day (321 ppb). The breakdown of the numbers is:

26 Day average	182 ppb	0.8 lbs/day
2 Day pumping from old Limestone Pit	39	0.2
1 Day detergent wash of Aroclor Dept.	58	0.3
2 Day removal collected PCB & solids in first part of new Limestone Pit	42	0.2
Total average:	321 ppb	1.5 lbs/day

From this it is obvious that we can no longer detergent wash the Aroclor department. When the second Limestone Pit is completed, the losses from digging and pumping should be eliminated. Two pits will allow switching to a clean pit when one becomes saturated with PCB.

Spills

Shutting the Aroclor department down for the New Years

MONS 099643

Day holiday caused the Therminol system surge tank to overflow when a valve leaked. The Therminol was caught in the department sump and no Therminol entered the plant effluent.

Projects and Evaluations

1. Supplied information to R. F. Seifert of CED covering solids containing PCB generated at Anniston for use in evaluation of PCB/solids incinerator tentatively located at WQK.
 2. Laboratory tests conducted by Betz Laboratory representative in our Anniston laboratories indicates that Bentonite Clay and Betz Polymer 1175 combination is very effective in removing solids from Limestone Pit effluent. Some mix will be tried by Denver Equipment Laboratories and then clarifier size recommendations will be developed.
- Pilot scale unit utilizing Biodize clarifier under construction. Startup is targeted for February 1.
3. Construction of No. 1 Limestone Pit 90% complete. Will meet 2/1/71 construction completion unless delayed by weather.
 4. Approximately 20 tons of inert material pumped from effluent end of pit (along with 260 pounds of PCE adsorbed on the inerts) on 12-18-70. This approach has added one month to the effective pit life at this time and can be repeated several more times.

W B Papageorge

W. B. PAPAGEORGE

ms

MONS 099644

B2BL Y. L. George

September 1, 1971

CJBA E. Greene
5260 Y. Katsyama

TERMINAL FR FLUIDS

5210 J. Culver
5020 R. F. Cornworthy
5090 D. Goodwillie
5040 P. J. A. Marsh
C228 G. W. Sperberg

File Terminal FR

APR 1972
George
Pat
Perig
Plum
Jim

Because of increasing PCB environmental pressures and questions as to whether we can effectively "close the loop" and eliminate leaks in heat transfer systems, we have decided in the United States to initiate a policy of no new systems on Therminal FR fluids. We intend that there will be no exceptions to this policy. Currently, all systems about to be filled, or in design stage, are being changed where possible to Therminal 55 or 66. Existing users are being reviewed and heavy leakers will be converted. We anticipate that long range Monsanto will not be selling FR fluids except in some select, carefully controlled systems. Shortly, a program will be initiated within the United States to encourage conversion of many remaining FR users to Therminal 55 or 66.

Concerning other world areas, we would like the following to be implemented. I know many of you are already proceeding on this basis:

1. Recheck your user list and make certain you have no food, animal feed, pharmaceutical, or food related (such as certain canners and other processes related to packaging materials) users.
2. Accept no new FR systems. Convert those about to be filled or in design, where possible, to Therminal 55 or 66.
3. Advise us of your existing users, their application, the end product they produce, and the quantity of the fluid in the system.

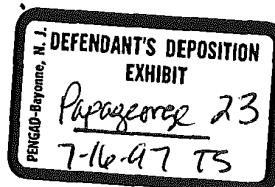
You subsequently will receive information concerning the United States program to convert many remaining FR users to 55 or 66.

If you take exception to any part of this worldwide program or if there is any specific customer case that requires further clarification, please let us know immediately.

Y. L. George

/ph

MONS 098533



THUNDERBOLT FR FLUIDS

-2-

September 1, 1971

NOTE TO MONSERS, GARESUORTHY AND MARSH:

Red-Lloyd Ship

Jim Rader has asked Peter Marsh and John Haggart for the latest information on the ship traffic to Australia and Red Lloyd's anticipated needs.

The fluid is still in use on the ships and they are operating. You should be hearing more from them shortly. Your inventory of approximately 45 drums of FR-1 is very high for the traffic you have experienced over the last two years. Red-Lloyd should be able to give us their anticipated needs and, depending on this, I believe we will want to reduce or eliminate your FR stocks.

T.L.G.

/ph

MONS 098534

COPY

DATE

December 8, 1971

JOB

THERMINOL CONVERSION BULLETIN

INTRODUCTION

Therminol FR® fire-resistant heat transfer fluids have long provided safe, dependable, ~~economic~~ performance for hundreds of users in dozens of applications. The presence of poly-chlorinated biphenyl (PCB) in the Therminol FR formulation provides fire-resistance, giving Therminol FR an added margin of safety which was especially desirable in hazardous applications.

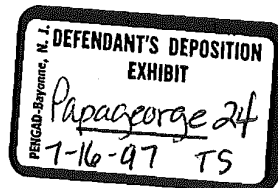
Most recently, PCB has been identified as a potential hazard to the environment. Monsanto has accordingly elected to discontinue the manufacture and sale of Therminol FR fluids for heat transfer applications, and has undertaken the rather substantial task of converting Therminol FR users over to the non-PCB-containing formulations, Therminol 55 and Therminol 66.

These products offer most of the excellent heat transfer characteristics of Therminol FR fluids, and even a few additional advantages, such as a lower bulk specific gravity for improved pumpability requiring less horsepower. But in fact, Therminol 55 and 66 are not fire-resistant to the extent the Therminol FR fluids were, and due consideration must be given this fact in converting to these ~~newer~~ ^{alternates} Therminol fluids.

Conversion from a Therminol FR ^{fluid} system to a Therminol 55 ^{or 66 fluid} ~~system~~ will be a relatively simple, low-cost procedure in the ~~most~~ majority of cases. Incorporation of proper fire protection equipment will be the only consideration

MONS 079843

Monsanto



in most cases.
of any major consequence. But even this modification becomes academic,
for with the discontinuation of Therminol FR fluids, fire protection equip-
ment becomes necessary for any and all ^{low pressure} heat transfer media available today,
since the Therminol FR fluids were unique in their fire-resistance.

This bulletin is to assist you in making the conversion to Therminol 55 ^{or 66} ~~55/66~~
as quickly, efficiently and economically as possible. Should questions
arise, or if you run into difficulty, Monsanto's Specialty Products Group
invites you to call upon its staff of qualified systems engineers for con-
sultation at any time. Call...

(314) 694-1000

collect, and ask for a Monsanto Heat Transfer specialist.

Thank you.

MONS 079844

⁶⁶
Therminol 55⁶⁶ and Your Heat Transfer System

Table I. shows the typical physical, chemical and thermal properties of Therminol FR-1, ~~and~~ ^{Therminol 66} Therminol 55⁶⁶. As you will note, the ^{three} ~~two~~ products are quite similar except with regard to AIT, Fire Point and Weight per Gallon. The substantially lower weight per gallon of Therminol ^{55 and} 66 means that pumps used in a Therminol FR-1 system ^{should} ~~will~~ be ~~more than~~ adequate for a Therminol ^{55 and} 66 system. ~~In fact,~~ In most cases, pumping rates will be increased with a resultant saving in horsepower requirements.

Therminol ^{55 and} 66 has ^{excellent} ~~outstanding~~ heat transfer properties, so ^{heating and cooling performance will} ~~nothing will be~~
~~not be sacrificed from that standpoint~~ in a change from Therminol FR-1. The specific heat and thermal conductivity of Therminol ^{55 and} 66 are shown, along with other physical properties, in Table ^{2, 3 & 4} II. The lower pour point ^{55 and} of Therminol 66 ^(-150°F) ~~(-150°F)~~
^{will provide cold start-up of} ~~means it will be easier to bring the system to temperature for cold start-up.~~

Generally speaking, then, a well designed system currently operating on Therminol FR-1 can be converted to Therminol ^{55 and} 66 with few, if any, basic changes in design -- and without sacrifice to heat transfer efficiency. With the similarity of the heat transfer properties of the ^{three} ~~two~~ fluids thus established, let us turn to the important differences between Therminol FR-1 and Therminol ^{55 and} 66 : namely, fire-resistance and oxidation-resistance.

Fire-Resistance

As stated in the Introduction to this bulletin, the Therminol FR fluids were unique in their inherent fire-resistance. No other commonly used heat transfer medium could be so classified. Even so, the Therminol FR fluids could be made to burn under certain conditions, as indicated by their AIT of something around 1200°F.
^{and fire points within their boiling ranges.}

TABLE 2

THERMINOL FR-1

VARIATION OF PROPERTIES WITH TEMPERATURE

Temperature		Density		Specific Heat		Thermal Conductivity		Viscosity		Vapor Pressure	
°F	°C	lb/gal	Kg/m ³	BTU/lb °F	Kcal/Kg °C	BTU/ft hr °F	Kcal/m hr °C	Cp	Cs	mmHg absolute	Kg/cm ²
50	10	11.68	1399.6	0.272	0.272	0.06098	0.0907	308	220	-	-
100	38	11.46	1372.7	0.282	0.282	0.06050	0.0902	23.2	16.9	-	-
150	66	11.22	1343.7	0.291	0.291	0.06021	0.0896	6.6	4.9	-	-
200	93	10.99	1316.7	0.3047	0.3047	0.05975	0.0889	3.4	2.5	-	-
250	121	10.76	1289.1	0.3151	0.3151	0.05927	0.0882	2.3	1.8	-	-
300	149	10.53	1261.3	0.3255	0.3255	0.05875	0.0874	1.4	1.1	-	-
350	177	10.30	1233.5	0.3359	0.3359	0.05819	0.0866	1.0	0.8	10	0.0136
400	204	10.07	1205.8	0.3464	0.3464	0.05760	0.0857	0.8	0.7	27	0.0357
450	232	9.83	1178.0	0.3568	0.3568	0.05697	0.0848	0.6	0.5	65	0.0884
500	260	9.60	1150.2	0.3672	0.3672	0.05630	0.0838	0.5	0.4	143	0.1945
550	288	9.37	1122.5	0.3776	0.3776	0.05550	0.0827	0.4	0.4	291	0.3958
600	316	9.14	1094.7	0.3880	0.3880	0.05487	0.0817	0.4	0.3	550	0.7480
650	343	8.91	1066.9	0.3985	0.3985	0.05409	0.0805	0.3	0.3	18.8psia	1.3218
700	371	8.68	1039.3	0.4089	0.4089	0.05329	0.0793	0.3	0.3	31.9psia	2.2429

MOMS 079846

TABLE 3
THERMINOL 55

VARIATIONS OF PROPERTIES WITH TEMPERATURE

Temperature		Density		Specific Heat		Thermal Conductivity		Viscosity		Vapor Pressure	
°F	°C	lb/gal	Kg/m ³	BTU/lb °F	Kcal/Kg °C	BTU/ft ² hr °F	Kcal/m ² hr °C	Cp	Cs	mmHg absolute	Kg/cm ²
0	-18	7.62	915	0.420	0.420	0.0813	0.1210	1472	1610	-	-
100	38	7.31	878	0.472	0.472	0.0784	0.1167	25.4	30.1	0.5	0.001
200	93	7.00	840	0.522	0.522	0.0753	0.1121	4.20	5.0	3.0	0.004
300	149	6.69	803	0.572	0.572	0.0724	0.1077	1.69	2.10	10	0.014
400	204	6.39	766	0.620	0.620	0.0692	0.1030	0.904	1.18	40	0.054
500	260	6.07	729	0.670	0.670	0.0661	0.0984	0.583	0.80	100	0.136
600	316	5.76	691	0.718	0.718	0.0630	0.0938	0.415	0.60	250	0.330
MONS 079847											

TABLE 4

THERMINOL 55

VARIATION OF PROPERTIES WITH TEMPERATURE

Temperature		Density		Specific Heat		Thermal Conductivity		Viscosity		Vapor Pressure	
°F	°C	lb/gal	Kg/m ³	BTU/lb °F	Kcal/Kg °C	BTU/ft hr °F	Kcal/m hr °C	Cp	Cs	mmHg absolute	Kg/cm ²
0		8.67	1040	0.320	0.320	0.0720	0.1072	62000	50000		
50	10	8.51	1020	0.350	0.350	0.0711	0.1058	255	250		
100	38	8.34	1000	0.380	0.380	0.0703	0.1046	28.0	28.0		
150	66	8.14	975	0.405	0.405	0.0695	0.1034	9.75	10.0		
200	93	7.91	950	0.430	0.430	0.0687	0.1022	4.18	4.40	0.1	
250	121	7.77	930	0.455	0.455	0.0678	0.1008	2.42	2.60		
300	149	7.59	910	0.480	0.480	0.0670	0.0997	1.55	1.70	2.0	0.003
350	177	7.39	885	0.505	0.505	0.0662	0.0985	1.06	1.20		
400	204	7.17	860	0.530	0.530	0.0653	0.0972	0.77	0.90	20.0	0.027
450	232	7.04	840	0.555	0.555	0.0645	0.0959	0.58	0.69	50.0	0.068
500	260	6.75	810	0.580	0.580	0.0637	0.0948	0.45	0.55	100.0	0.136
550	288	6.62	793	0.605	0.605	0.0628	0.0935	0.36	0.46	200.0	0.272
600	316	6.42	770	0.630	0.630	0.0620	0.0923	0.34	0.44	350.0	0.475
650	343	6.24	750	0.655	0.655	0.0613	0.0912	0.27	0.36	750.0	1.034
700	371	6.09	730	0.680	0.680	0.0605	0.0900	0.20	0.28	1000	1.350

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^{These} points ^{are} made to emphasize that, although Therminol ^{55 and 66} 66 ^{are} certainly less fire-resistant than Therminol FR-1, ^{fluids, like} it should be viewed in that perspective; ^{but not highly} ~~and not as~~ ^{flammable} "flammable". On a scale of fire-resistance where water would be rated as "0" and ether as "100"; Therminol FR-1 would be rated "3", and Therminol 55 and 66 would fall somewhere between "15" and "20". It is important to realize that Therminol 66 ^{55 and 66} ~~is~~ ^{are} less fire-resistant than Therminol FR-1, and to modify the heat transfer system accordingly: it is equally important to understand that Therminol 66 ^{55 and 66} ~~is~~ ^{are} not a volatile, highly flammable fluid; ~~of itself~~, but rather ^{combustible} fluids as ^{referred to by} FM and NFPA.

Protecting the System

There are two major fire protection considerations in changing to Therminol ^{55 and 66} 66 -- system leakage and possible tube rupture (in the heater). The former is actually part of the larger subject of good system maintenance, and should be considered regardless of the heat transfer medium employed. A tight, well-maintained system is usually a good, safe system! Following are some specific recommendations to prevent leakage when you convert to Therminol ^{55 and 66} 66.

First, if your system has ^{rotary} mechanical seals, you should enclose them, or at least provide a drip pan with a drain to a collection pump. Canned and sealless pumps offer excellent protection against leakage.

The best way to prevent piping leakage is to weld all connections. Where you must have access, use raised-face flanges with appropriate gasketing and high-temperature bolts. Controlling piping leaks is especially important, since fluid-soaked insulation poses a more serious hazard than the leaking fluid, itself.

Organic compounds such as Therminol 66 ^{55 and inhibit} ~~appear to create~~ a slow exothermal oxidation reaction with the air trapped inside the voids of the insulating material when system temperatures reach about 500°F. Saturated insulation offers a large fuel surface in the face of poor heat dissipation conditions, and this, along with possible catalysis from the insulating material (magnesia, silicate-bonded asbestos or calcium silicate) can cause a temperature build-up in the mass. This temperature build-up can ~~result in a reaction~~ ^{result in a reaction} of the fluid ~~and~~ when the space between the piping and the saturated insulation is exposed to air, (i.e., should the insulation be broken for repair, etc.), ~~fire can result~~

This phenomenon is not fully understood, but appears to occur less with closed cell insulation than with the insulating materials mentioned above. Closed cell materials, then, are preferred, especially where leakage is a possibility despite all precautions.

The principle problems areas are near ^{instrument} thermocouple connections, valve packing glands, flanges, and ^{where cracks develop in relatively impermeable} ~~wherever insulation contacts horizontal flat surfaces, such as floor plates~~ ^{insulation cement adjacent to oil soaked insulation.}

To obviate this problem, eliminate any source of leakage promptly. Replace leaky gaskets, ^{oil soaked insulation and} ~~use flange backup rings~~, re-pack valve stems. Cover insulation where leaks might occur with a hydraulic-setting, oil-resistant cement. Install valves, where possible, with the stems in a horizontal position so that leaks will drip away from the insulation. And again, use closed cell insulating materials on suspect piping areas.

Tube Rupture In Fired Heaters

Generally speaking, where fire protection is concerned, it is best to consult your insurance underwriter for guidance and counsel. Likewise, you will want to discuss your fire safety equipment requirements with ^{qualified} ~~top-notch~~ suppliers ^{of fire protection equipment} ~~in that field.~~ Selection and sizing of fire protection equipment ^{is important to} ~~are critical.~~ ^{safe guard the installation.}

In the case of tube rupture in fired heaters, we recommend ~~the~~ piping ~~of~~ either steam or CO₂ as a snuffer into the combustion chamber of the heater. A minimum one-inch line with a remote manual valve for activation ~~should a fire erupt~~ ~~internally~~ is the preferred arrangement. This snuffer system can be automated by the use of an exhaust stack temperature switch. This switch would energize a solenoid valve ^{and alarm} upon excessive temperature rise, ^{is automatically} flooding the chamber with ^{a fire extinguishing} ~~the~~ ~~snuffer automatic~~ ~~equipment.~~ ~~manual activation~~

It is advisable to set the temperature switch about 100°F. over the normal exhaust temperature to prevent nuisance shutdowns. If a steam snuffer system is used, it is a good idea to employ a steam trap to avoid slugging the combustion chamber with water when the system activates, or is activated manually.

You can obtain a basic guideline in the selection of CO₂ protection equipment (again, it is best to consult your insurance underwriter) from the National Fire Protection Assn.,

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Booklet Number 12, dated 1968. In this publication, it is stated that a minimum CO₂ concentration of 46% in the combustion chamber will extinguish a ^{small} Therminol fire. The following table will be useful in determining the volume of CO₂ required:

Volume of Combustion Chamber - Cubic Feet	Calculated Quantity*	Temp. Corrected**
	CO ₂ Pounds	CO ₂ Pounds
0 - 140	15	30
141 - 500	15	30
501 - 1600	53	106
1601 - 4500	150	300

* Calculated quantity of CO₂ required to maintain 46% concentration by volume at temperatures of 200°F. or less.

** Temperature corrected quantity of CO₂ required to maintain 46% concentration by volume at temperatures of 700°F. (Rule of thumb: increase volume of CO₂ by 1% for every additional 50°F. over 200°F.)

CO₂ cylinders are available from Cardox Division of Chemetron, Chicago, Illinois. Standard sizes available and approximate costs are as follows:

CO ₂ Pounds Cylinder Size	Single Automatic	Double Automatic
50	\$410	\$610
75	\$460	\$710
100	\$650	\$980

These units and prices include drawings of the units, fully-

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charged cylinders, flexible piping connectors, spray nozzle, pressure switch, alarm and automatic control, provided CO₂ release signal is supplied by customer device. Piping, wiring and installation labor is provided by the customer. Recharging of cylinders is available at a cost of \$15.00 to \$25.00 from a variety of "Fire & Safety Equipment Suppliers" listed in the Yellow Pages of your phone book.

In the normal installation a single cylinder would be released to extinguish the fire, with a second unit available as standby. The second cylinder could actually be used for extended discharge to maintain maximum concentrations, since some CO₂ will obviously be lost by leakage from the combustion chamber. This arrangement could prevent re-ignition while the heater is cooling.

The Halon[®] Fire Suppression System is a possible alternative to a CO₂ arrangement, and can be used in closed spaces with personnel in the area. Far less concentration is required than with the CO₂ system, but the Halon[®] system is more costly to recharge, facilities to do so are not as readily available, and the latter system is a "fire suppression" arrangement as opposed to a "fire extinguishing" system.

Again, we strongly recommend that the advice of fire protection companies be solicited in either case to insure proper equipment selection and installation.

~~FIGURE~~
~~Table~~ 1 shows the amounts of snuffing steam required in the combustion chamber for control, if steam is to be used rather than the other alternatives suggested above.

MONS 079853

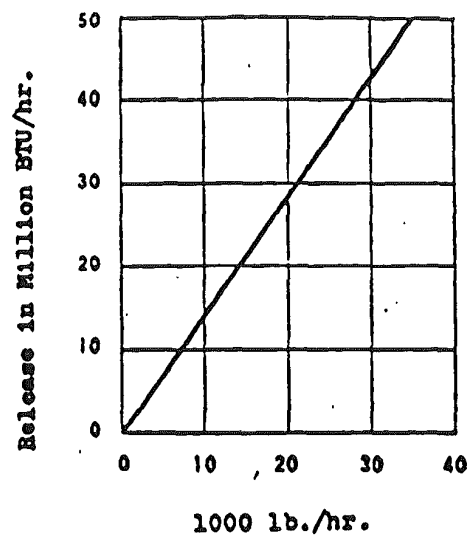


Figure / -- Rate of Steam
Introduction in 1000 lb./hr.

MONS 079854

Oxidation-Resistance

With a Therminol^{55m} 66 system, some provision should be made to prevent oxidation caused by air contact at fluid temperatures exceeding 200°F. This was not the case with Therminol PR fluids, but must be observed for the newer-generation fluids.

Oxidation can result in sludge formation, eventually leading to ~~some~~ carbonaceous deposits on heat transfer surfaces and mechanical seal

faces. ~~fluid can develop by air contact in~~
Oxidation ~~is normally the product of~~ an open, vented expansion tank, ~~and~~ ^{but} therefore recommend that the expansion tank be blanketed with an inert gas. ^{such as nitrogen, shown in Figure 2} If this is not possible, ~~an inert~~ ^{can be minimized by} a cold seal arrangement as shown in Table ^{ENR 3} 3. An inert gas pressure of one to two psi ^{is} should be adequate, as Therminol 55 and 66 ~~do not~~ require pressurization.

You can design the cold seal arrangement quite simply by piping the expansion tank vent to a second tank where the vent line ^{projects} ~~sub surface and~~ can be flooded with additional Therminol^{55m} 66 to ^{minimize} prevent air ingress ~~contact in the vapor space.~~

In converting from Therminol PR to Therminol^{55m} 66, it is important to remember that many Therminol PR systems were designed with a hot bleed line into the expansion tank to eliminate moisture accumulation. This bleed line should be ~~eliminated in a~~ ^{removed off during operation}
of the ^{55m} Therminol 66 system.

Carbonaceous deposits can also occur at the pump seal face due to leakage at high temperatures. The use of a sealant flush system or a double mechanical seal is helpful in preventing ~~the~~ excessive seal wear.

MONS 079855

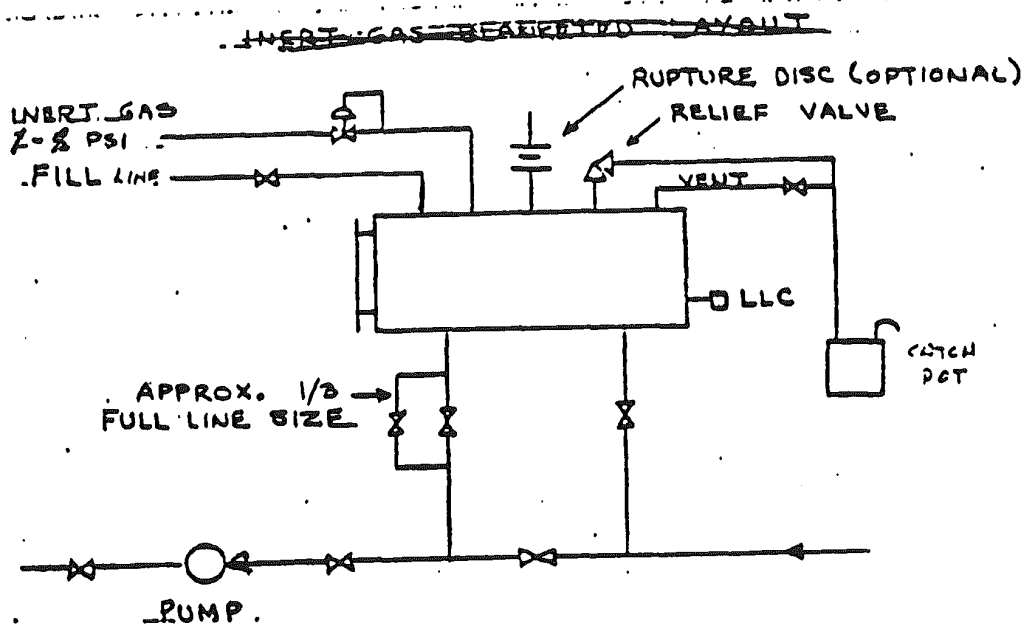


FIGURE 2

SUGGESTED INERT GAS ARRANGEMENT
FOR EXPANSION TANKS

MONS 079856

~~SUGGESTED~~
~~EXPANSION TANK LAYOUT~~

~~COLD SEAL LAYOUT~~

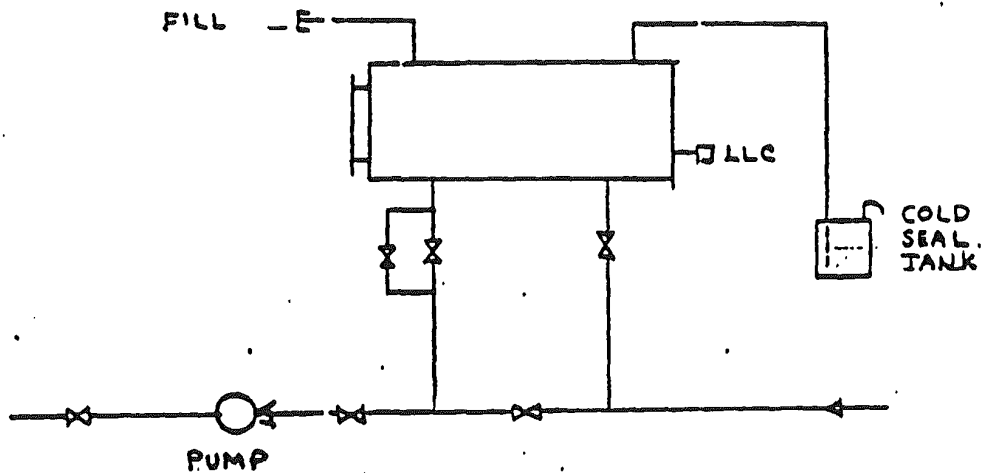


FIGURE 3

SUGGESTED COLD SEAL TRAP ARRANGEMENT
FOR EXPANSION TANKS

MONS 079857

CONVERTING TO THERMINOL 66

With fire-protection and oxidation-resistance procedures well in mind, let us turn to the matter of preparing the Therminol FR system ^{for} to ~~accept~~ ^{use} Therminol 66.

The most expedient procedure would be to simply drain and change the system to Therminol 66. However, expedience is not always the best alternative, and certainly not in this case.

Debris, accumulated over the years in the system, could cause serious problems, especially to mechanical seals, rotary joints, etc. (~~see suggested expansion tank layout, Page 1~~). ^{all} ~~the~~ heat transfer systems should be ~~drained~~ and cleaned from time to time as a part of normal preventive maintenance. Since a fluid change is necessary at this time, it would seem ~~logical~~ ^{practical} to use the downtime to ^{thoroughly} clean ~~the~~ the system ~~and~~ ^{then to} start ^{on a} fresh charge of fluid. We ~~would~~ strongly advise you not to simply drain and change, but to take this opportunity to clean your system. Many potential problems will be preempted by so doing.

^{Another} ~~The other~~ reason for cleaning your system at this time is that ^{to assure} ~~complete removal of the Therminol FR fluid~~ ~~the system should be completely purged of PCBs~~, and a system cleanout is the only sure way to do so. How to go about the cleanout is a matter of choice, but here are some alternatives for your consideration:

A. CHEMICAL CLEANING

This method is particularly effective in cleaning heavily-fouled heating surfaces.

MONS 079858

Cleaning service may be purchased from Dow Industrial Service Company or Halliburton...or, it may be done in-house using Oakite cleaning products or caustic soda and soda ash. Consult the Yellow Pages of your phone book for the above services and suppliers.

Chemical cleaning procedure with caustic soda and soda ash follows: contact Oakite for detailed information on their procedure.

Chemical Cleaning - Caustic Soda and Soda Ash

1. Fill empty system with cleaning solution containing 5 lb. caustic soda and 5 lb. soda ash per 120 gallons of water.
2. Initiate circulation* and heat liquid to 180°F.
3. Circulate 24 hours, periodically drain fluid from a low point and replace with clean water. Do this until fluid in system is clear (about 24 hours).
4. When fluid in system is clear, raise temperature to 215°-225°F, stop pump and heater.
5. Quickly drain system, open all vents, and allow residual heat to dry system.
6. Assure system is dry.
7. Fill with Therminol ~~fluid selected~~ ⁵⁻⁶⁶ 66.

*May be desirable to pack pump with Teflon filled asbestos packing to prevent damage to mechanical seal faces.

MCNS 079859

B. FLUID FLUSH CLEANING

This ~~system~~^{method} is probably the fastest and most effective where heating surfaces are not heavily fouled. It also offers the advantage of not having to introduce foreign chemicals into the system.

With this method, the system is drained of Therminol FR, re-filled with Therminol 55⁵⁵ ~~(Therminol 55 may also be used)~~, 66⁶⁶ operated for a reasonable period of time; drained once again; and finally, re-charged with fresh Therminol 66⁵⁵.

Both the drained Therminol FR and the Therminol 55/66 used to flush the system may then be returned to Monsanto for disposal at no cost to you, assuring you of a PCB-free system, and a fresh start.

C. SOLVENT CLEANING

This method is satisfactory for cleaning a slightly soiled system, but chlorinated solvents must be avoided. Typical solvents used are acetone, benzene, kerosene and xylol. Do not use trichlorobenzene or perchloroethylene. (CAUTION: ALL SOLVENTS SHOULD BE COMPLETELY REMOVED FROM THE SYSTEM PRIOR TO CHARGING WITH THERMINOL 66).⁶⁶

MONS 079860

Fluid Disposal

All drained Therminol FR and Therminol 55/66 flushing fluid should be returned to Monsanto for incineration. This service is provided at no cost to you, and assures proper elimination of PCBs from the environment.

All such material should be shipped to:

Monsanto Company
W. G. Krummrich Plant
Sauget, Illinois
ATTN: Supervisor, Dept. 246

Please make certain that shipped materials are properly ^{sealed and} identified.

As stated earlier, Monsanto maintains a staff of qualified engineers who will be available for consultation should you have questions or run into difficulties. The number to call, again, is (314)694-1000; ask for a Monsanto Heat Transfer Specialist.

Thank you.

MONS 079861

^{55 and}
THERMINOL 66

SAFETY OF HANDLING

^{55 and}
Therminol 66 ^{is} virtually non-toxic and non-irritating, posing no special handling problems. ^{They are} ~~It is~~ not absorbed through the unbroken skin in significant quantities, ^{is} ~~is~~ non-irritating to the skin and only mildly irritating if eye contact occurs. Immediate flushing of the eye with copious amounts of water will avoid irritation or after-effects. It is suggested that Therminol ^{55 and} 66 be washed off the skin with soap and water, as soon as possible after contact, but no serious irritation should ^{result} ~~be observed~~. Handled like any other industrial chemical, Therminol ^{55 and} 66 ^{is} quite safe to store and use.

^{Vapors from}
Therminol ^{55 and} 66 vapors are not ~~extremely~~ toxic, but may cause discomfort if coming off of heated fluid. There is no vapor exposure problem when transferring the fluid from its shipping container to the heat transfer system. On the other hand, vapors emitted by Therminol ^{55 and} 66 heated to elevated temperatures may be mildly irritating upon prolonged exposure. In heat transfer installations, the fluid is used in a closed, unpressurized system free from leaks and with the expansion tank vent trapped so as to condense any vapors. Consequently, there should be little or no opportunity for workers to come in ~~any~~ contact with vapors. ~~A tight maintenance program is the best answer to employee exposure.~~

MONS 079862

While Therminol ^{SS and} 66 poses no serious problems with respect to the environment, as a concerned supplier to industry, Monsanto urges the user to maintain a tight system, to correct leakage promptly, and to exercise care in the handling and disposal of this and all other such products. A tight maintenance program not only protects the environment, but keeps employees comfortable, the working area clean, and the system running smoothly.

MCNS 079863

FIGURE I

THERMINOL[®] FR-1

PHYSICAL PROPERTIES

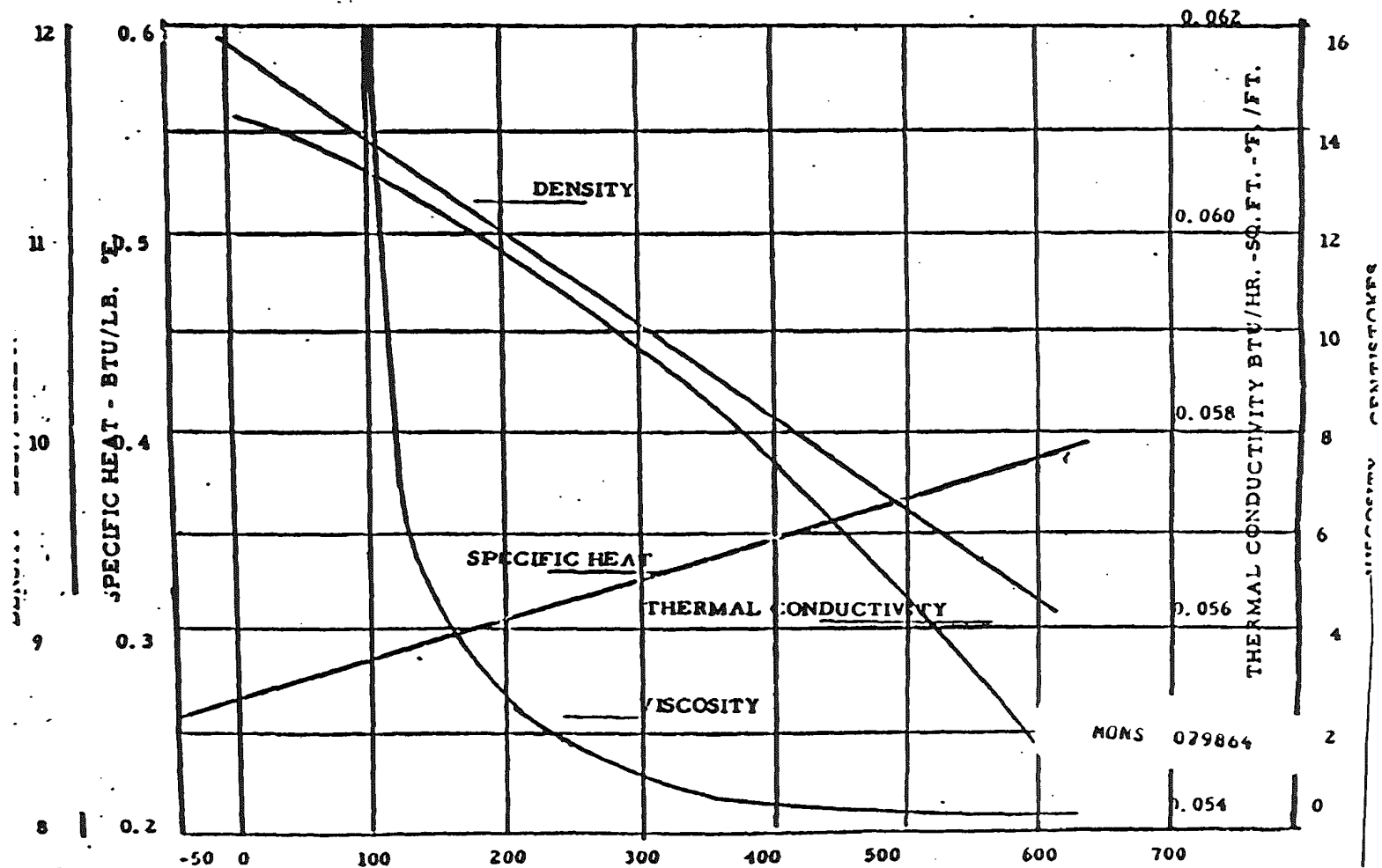


FIGURE 11
THERMINOL® 55
PHYSICAL PROPERTIES

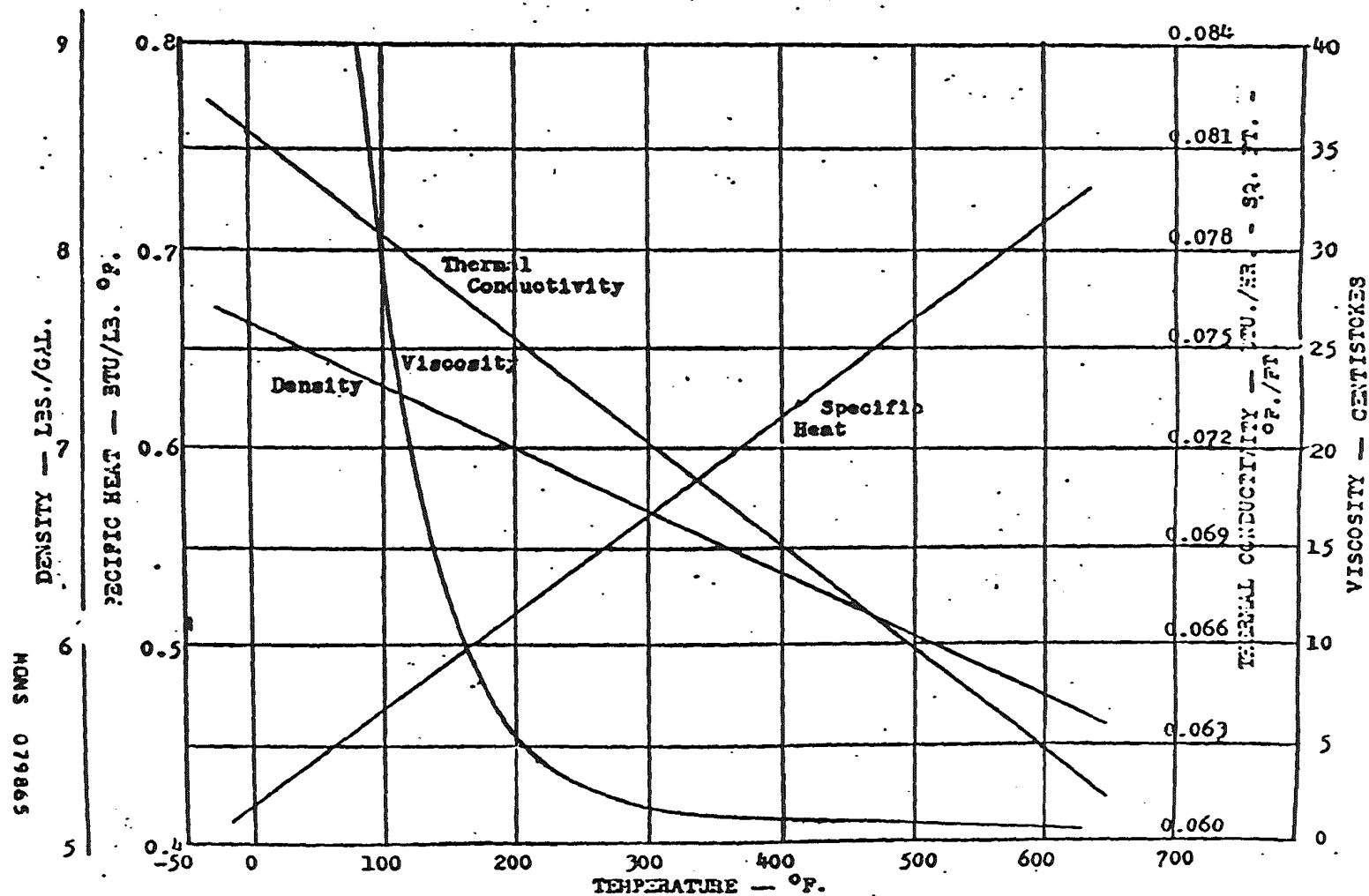
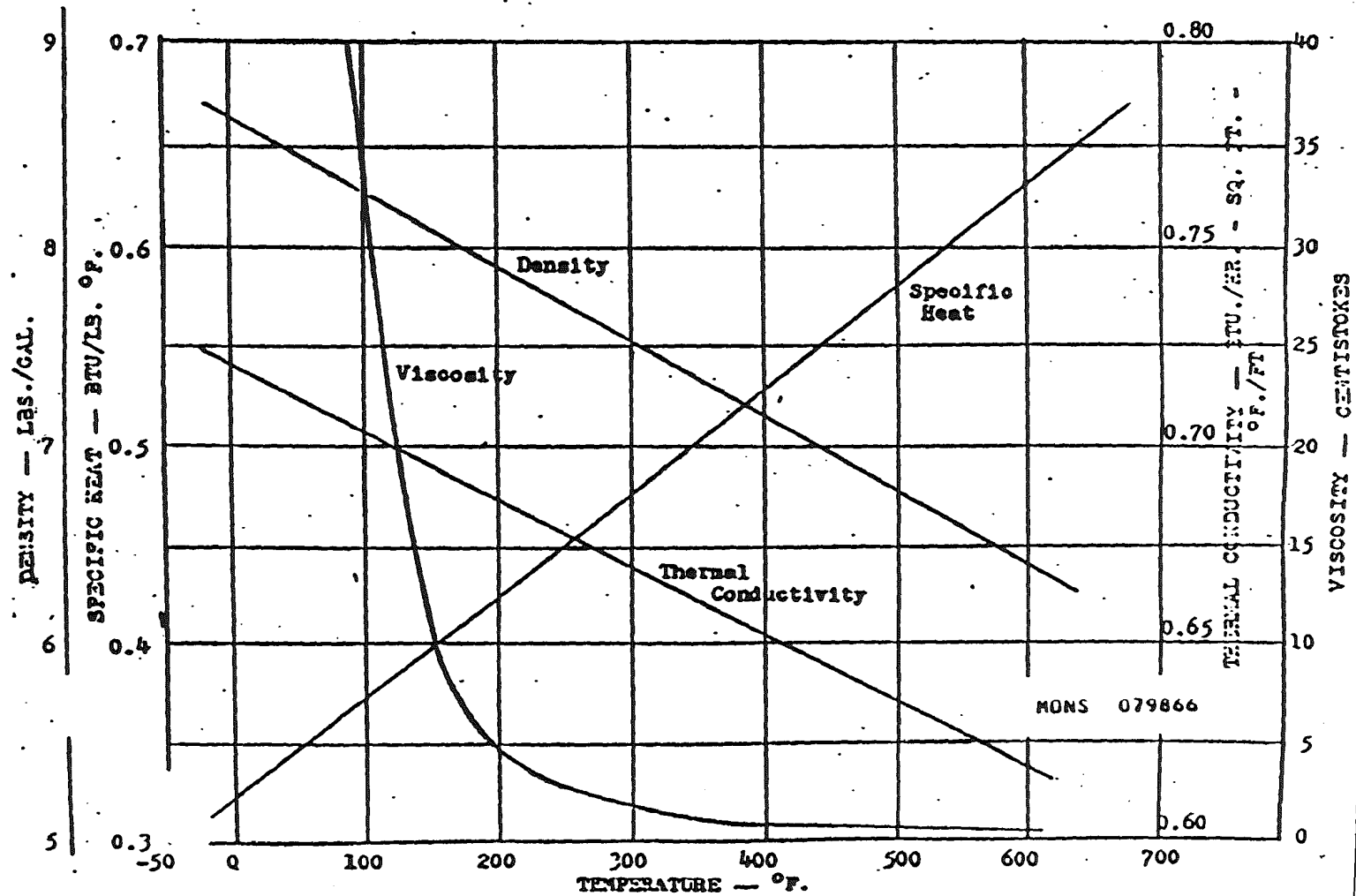


FIGURE 66
THERMINOL® 66

PHYSICAL PROPERTIES



Monsanto

SPECIALTY CHEMICALS DIVISION

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63186
Phone (314) 694-1000

August 7, 1978

Dear Sirs:

EPA Proposed Rule: Polychlorinated Biphenyls (PCB's)
Manufacturing, Distribution In Commerce and Use Bans.

On June 7, 1978, the United States Environmental Protection Agency ("EPA") published a proposed rule in 43 Federal Register beginning on page 24,802 covering Manufacturing, Processing, Distribution in Commerce, and Use Bans of Polychlorinated Biphenyls (PCB's). We attach a copy for your information.

We believe that your company may have used Therminol® FR series heat transfer oils prior to their replacement by non-PCB fluids. If adopted, the proposed rule, on its effective date, would ban the operation of heat transfer systems containing residual PCB concentrations above 50 parts per million.

Monsanto is submitting to the EPA the attached comments which suggest and/request alternatives to the proposed rule and a specific authorization for the continued operation of heat transfer systems containing residual PCB concentrations.

Since there is very limited reference to PCB's in heat transfer systems in the proposed rule, we wished to ensure that you were aware of its potential impact on your operations.

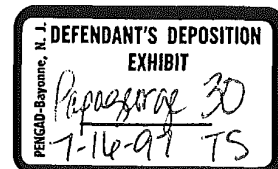
In the event that you converted systems from Therminol FR heat transfer fluids to our non-PCB fluids, Therminols 55 or 66,

continued . . .

®"Registered Trademark of Monsanto Company"

REY 000073

a unit of Monsanto Company



WATER_PCB-SD0000064226

Page 2

August 7, 1978

we attach copies of methods for determination of PCB levels in these fluids.

We hope that our comments will be helpful in your own assessment of the potential impact of this rule.

Sincerely,

A handwritten signature in dark ink, appearing to read "D. Wood", is written over a horizontal line.

D. Wood
Market Manager
Heat Transfer and Process
Phone: 314-694-2623

tmc
enclosures

REY 000074

COMPANY NAME

SUBSIDIARY OF

Reynolds Metals Company ✓
Reynolds Metals Building
Richmond, Virginia 23261

REY 000075

August 31, 1970

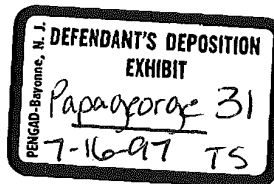
Mr. Bruce S. Hulcher
Environmental Control Engineer
Reynolds Metal Company
Richmond, Virginia 23218

Dear Mr. Hulcher:

Your letter dated August 20, 1970 addressed to Mr. Donald Olson was forwarded to me for response since I have been given the responsibility for studying the PCB environmental problem.

We do not have specific research data on the persistence of Pydraul products in the environment but we have studied the PCB's that are principal components in Pydrauls. Our studies to date have confirmed our suspicions that the higher chlorinated biphenyls are more persistent than those containing less chlorine. Because of this persistence we strongly recommend that liquids containing PCB be kept away from water systems, e.g. sewers, creeks, rivers, lakes, etc.

Pydrauls which are no longer usable should be destroyed by incineration at temperatures exceeding 800°C. Stack gases from the incineration must be scrubbed and neutralized to prevent HCl from escaping to the atmosphere. If incineration facilities are not available, you may wish to send the scrap liquid to Monsanto Company, W. G. Krumrich Plant, Sauget, Illinois, Attention Supervisor Department 246. The cost of incineration has been tentatively set at 3 cents per pound of material received and does not include freight and container costs.



REY 000395

Water contaminated with Pydraul should be treated to remove the free Pydraul and finally passed through a bed of activated carbon to lower the PCB content to less than 10 ppb.

Solids contaminated with PCB should be segregated from other plant waste and buried in a properly operated landfill located away from water bodies.

The disposal methods described above apply specifically to Pydrauls formulated with persistent PCB's. As you probably know we are reformulating our Pydrauls to reduce the persistence problem. Some reformulated Pydrauls are now available with others scheduled for availability within the next few months.

Regarding your request for a list of firms marketing fire-resistant fluids, it appears that because of the number involved, 20 - 30, you might achieve your objective more quickly if you refer to those firms with which your purchasing organization normally transacts business.

I have enclosed copies of technical articles related to the PCB environmental problem which you may find helpful.

If I can be of further service, please let me know.

Sincerely,

W. B. Papageorge
Manager, Environmental Control

/jk
Enclosures

CC: Mr. Donald Olson
Monsanto Company

BCC: N. T. Johnson

REY 000396

MONSANTO'S PCB PROGRAM

W. B. PAPAGEORGE

Presented at ANSI Committee C-107
Meeting - September 14, 1971

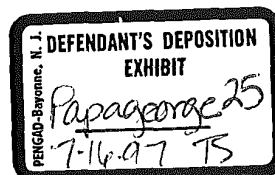
I appreciate the opportunity to share Monsanto's PCB experience with you and I hope the information I have can help this committee plan and achieve its objectives.

We at Monsanto first heard of PCB's as potential environmental contaminants in early 1967 when we received copies of a talk given in Sweden by Professors Widmark and Jensen of the University of Stockholm. In their paper they described how they were able to identify a material which had been interfering with pesticide analyses as being polychlorinated biphenyls.

Our laboratories began work on the development of analytical methodology to confirm that PCB's indeed were being found in the environment. During 1968 and 1969 as methodology improved the evidence continued to indicate that the higher chlorinated biphenyls were being identified in the tissues of fish and birds.

During this period Monsanto mounted an extensive program aimed at acquiring more knowledge about PCB's and their effect on the environment. We perfected our analytical methods, we started animal toxicity studies, began biodegradation work and evaluated alternative materials for those applications we felt were contributing substantially to contamination.

MONS 041633



Our animal toxicity work was similar to the type we would have undertaken if we had wished to have FDA approval for food use. Chronic toxicity and reproduction studies were made on leghorn chickens. Two year chronic feeding studies were started on rats and dogs. Three generation reproduction studies were made on rats.

The PCB's used in the tests were Monsanto's Aroclor 1242, Aroclor 1254 and Aroclor 1260. These were selected since they represented the more commonly used PCB mixtures. The animals were fed concentrations of 1 ppm, 10 ppm and 100 ppm in their normal diets. The results to date indicate that at the levels used the rats and dogs showed no effects with Aroclor 1242. At 100 ppm both the rats and dogs exhibited decreased weight gains and enlarged livers. The chickens were affected by Aroclor 1242 at the 10 ppm level. The hatchability of the eggs was significantly reduced.

To summarize what I've said about Monsanto's sponsored animal toxicity work the highly chlorinated polychlorinated biphenyls at 100 ppm in the animal diet does have some effect on mammals. The lower chlorinated polychlorinated biphenyls at 10 ppm in the diet has some effect on leghorn chickens, and I say specifically leghorn chickens because there is mounting evidence that there are definite species variations as determined by the Pautuxet Laboratories here in Maryland with four types of wild birds. There is a species variation noted which frustrates many scientists

MONS 041634

I was asked what we know about the effect on marine life. Monsanto did sponsor static fish toxicity work and we were completely frustrated because these PCB's have the tendency to plate out on surfaces. Our information was garbled because in the static testing we were really exposing the fish to PCB environments a lot less than we thought we were. The data was so distorted it was meaningless. In the meantime, we found that there are many competent laboratories looking at fish and the effects on fish that we decided that maybe this is an area that is best left to the experts.

We have been in touch with laboratories such as the Water Quality Laboratory of Duluth, Minnesota. They have conducted studies which indicate there is some effect on some species. There has been some work done in the Columbia, Missouri Bureau of Interior Fish-Pesticide Laboratory which indicates, for example, magnification about 50,000 times. By that I mean that the amount of PCB detected in the fish tissues was 50,000 times that present in the water environment in which this fish was exposed.

There have been reports of fish kills and some very drastic effects attributed to PCB's. I've tried to get evidence that these things have occurred. I have not been able to confirm any reported incident.

We have talked with scientists at the Gulf-Breeze, Florida Commercial Fisheries Laboratory. They have conducted studies

MONS 041635

with crab and shrimp. This is the laboratory that did detect a build-up in crab and also the lethal effect on juvenile shrimp. Very, very low concentrations - 5 ppb in the water - do destroy juvenile shrimp.

There is a growing thought among many of the responsible scientists that this environmental problem is most complex and it is not really any one insult that is the demise of any particular species, but it could be the cumulative effect of all insults a creature is exposed to and usually the last insult is the one that gets blamed. Dr. Tom Duke of Gulf-Breeze is a proponent of this theory and he is conducting studies to substantiate this. It could be the lack or presence of oxygen, the lack or presence of proper nutrients in the environment, the lack or presence of the proper temperature conditions, the exposure to a DDT or a cadmium or a mercury or an arsenic, and along comes a PCB and the fish dies. PCB might get blamed. This is the kind of thing that does happen in the environment.

There is a growing concern that we should be considering to a greater degree chronic effects of all these materials rather than relying on the old acute studies that used to serve as a screening for many, many chemicals. I have sketchy data on marine life. We know that it does build up in the marine environment and there is, of course, the published evidence that it does affect the fish eating birds.

MONS 041636

There is some indication in the Duluth studies that reproduction and survival of the frye is affected. There seems to be minimal affect on adult fish.

It was suggested earlier that I might want to review the manufacture of PCB's, the many applications in which it was used and what our present program is. To the best of my information, it was 1929 that these materials were introduced as very attractive fluids for use in transformers, and there are many in this audience that are more familiar with this development than I am. PCB's were used in transformers as an insulating cooling fluid because they are more resistant to breakdown, less apt to explode and burst into flames and cause property damage and human injury.

Through the years, additional uses were found for these materials because of these properties that I mentioned earlier. They gradually at first, and of course with increasing amounts, ended up in applications that Monsanto through its in-house usage referred to as plasticizer usages. That is not a very good description, but it fit our needs for many years, and you'll find us using that expression. These are uses such as in paint formulations, the specialty ink uses, the plasticizer in sealants, adhesives, and paper coatings of all sorts.

There was a use that was a real thorn in our side and you'll see at least some of the earlier articles on PCB's referring to pesticide use. There were some studies conducted by the Department of Agriculture in which PCB's were used to extend the effect of

MONS 041637

life of pesticides such as lindane. It was never intended for broadcasting as we visualize DDT was on food crops, cotton crops, or orchards. The only widespread use that I could find was a limited trial to help prevent or curtail the dutch elm disease, and that proved to be a failure. The other uses were extremely small in private formulations that were used to spray or coat hard surfaces - shelving, corners of floors and all for the typical crawling type insects such as the roach and silverfish. In fact it was so small that Monsanto did not market directly to pesticide formulators; we gave this business to our distributors. On the other hand, this use did cause considerable emotion and was used by some to explain the presence of PCB's in remote areas. We wrote to the Department of Agriculture suggesting that during 1970 when pesticides were being re-registered that PCB's not be approved. Finally in October they did put out a notice to that effect.

We have had questions raised, "Is it in my shower curtains at home? Is it in the draperies? In the Carpeting?" The answers to those is "not very likely". And I use those words because we really don't know. If it was put into these applications, it was so small we, Monsanto, were not aware of it. It was not used in automobile tires; it was not used in brake linings.

Other major uses include the use in hydraulic fluids which are fire resistant. Monsanto marketed these fluids under its trademark Pydraul. I am sure some of you remember the Livonia,

MONS 041638

Michigan fire? This was a disastrous fire in terms of property damage and was really a high mark in terms of convincing industry that there was a need for fire resistant hydraulic fluids. But the application is not the type that is maintained to a degree where everything is leakproof. Many of these connections leak, hoses burst, and the tendency is to keep producing by adding more fluid. So it is conceivable that many of these hydraulic fluids ended up in the sewer. I do not intend to criticize the customers of our products. From the knowledge that we had at that time of the material the practice was considered acceptable.

Another fairly widespread application of PCB's is the use of these fluids as a heat transfer media to achieve high temperatures, have a fire resistant transfer fluid, and avoid the installation of high pressure equipment. These materials were ideally suited for this application. We thought at one time that these were adaptable to close control and proper maintenance where we could logically call them closed systems. Some recent evidence indicated that we were wrong and I'll get into that when I discuss our present applications.

One application that was a fairly significant one and one that in our thinking is associated with coatings is the use in carbonless reproduction paper. With the emphasis on recycling paper, wastes and with the persistence of PCB's there is a problem developing in that PCB's are being found in many paper products and many of these paper products end up in food packaging.

MONS 041639

Initially the evidence we were getting seemed to point to the higher chlorinated materials as environmental pollutants. As soon as we were aware of this, we sent a letter to all of our customers telling them that what little we knew indicated that these materials could be an environmental problem, and care should be exercised in handling. When the results came in on our chicken toxicity studies they indicated that the lower chlorinated materials might be a problem regarding birds. We decided, as a company, that we better place some restrictions on these materials because there were to us some uses that deserved to be kept in spite of the problems that we saw facing us.

We decided that we've got to get out of those applications where we felt there was no earthly chance or it was beyond our ability to control the introduction into the environment, so we got out of all the so-called plasticizer applications. August 30, 1970 was the targeted effective date.

We then went into a very active program of reformulating the hydraulic fluids. There again, it required a lot of testing. We had to run these new materials through the Underwriters Laboratories for approval on fire resistance. They had to be compatible with the machinery then in use. This is not easily done, but it was done.

We decided that we could and must continue to supply the transformer manufacturer, the capacitor manufacturer, and at that

MONS 041640

time closed heat transfer systems based primarily on our concept that fire resistance was important in heat transfer.

To pick up the point that was raised earlier about foreign imports, we are to the best of our ability trying to monitor imports. To this day, we have no information that any have arrived in this country. On the other hand, we are getting some reports that some of our former customers have made inquiries of the foreign producers. I am also told by some Canadian provincial agency people that they had heard and were going to further investigate that PCB's were entering Canada and from there moved into the United States. I have talked to representatives of the Japanese producer, the Kanegafuchi Company, and I am led to believe that they are most reluctant to enter this business. On the other hand, the Japanese producers are the producers that are being accused of entering the U.S. market. I have talked to representatives of the French companies. They assure me that they don't want any part of this business.

In May, 1970 Congressman William Fitz Ryan introduced a proposed bill which would in essence place into law the very things that Monsanto had proposed doing on a voluntary basis. The bill provided that PCB's be banned except for those situations where the Secretary of HEW would give special permission or license.

We went through the latter part of '70 and early part of this year feeling, however, that we were still walking on thin ice.

MONS 041641

But we thought that we had made some tremendous strides in the right direction to preserve those uses which we thought were essential while eliminating those uses which were grossly contaminating the environment. This summer our hopes of control in the heat transfer business vanished when we found that a user of PCB did not appreciate the problem, did not maintain his equipment and created the recent chicken, egg, fishmeal problem.

Because of this incident, Congressman Ryan withdrew the first bill that was submitted and has now placed before the same committee a bill which totally bans PCB and does not provide for any use whatever. And there are, of course, penalties for the marketing, manufacture, or use of PCB in this country. A very drastic measure which does cause or can cause a lot of concern among those of us who feel that PCB has a place in our society under proper conditions.

As a result of this incident, we were forced to re-evaluate our position. We decided that, although heat transfer systems could be closed units, we are still at the mercy of the attitude of the operator of the equipment and we continuously faced the situation where even a pinhole leak can create tremendous problems before it can be discovered. So we have taken, again, an arbitrary position and informed all of our customers in the food (whether it's animal or human food), packaging business, and the pharmaceutical business, that we will no longer supply them heat transfer fluids which contain PCB's.

MONS 041642

In addition, we will no longer market to any new heat transfer applications. Our efforts will be concentrated on reducing those that we market today. This business should decrease as time goes on.

To get back to legislation ... as many of you probably know, there is before Senator Phillip Hart's committee a bill referred to as the Toxic Substances Act of 1971. The purpose of this bill is to prevent the introduction into our society of hazardous materials. It also provides for the review of materials now in our society and the curtailment of the use of the more hazardous ones. Initial hearings were held in August, to which a select few individuals were invited to testify. PCB was brought out as an example of a material introduced into society and thought at one time to be most valuable, but is now considered a serious threat to all of us.

The meetings will be resumed in October; I do not know the exact date as yet, and I'm led to believe that this would be the opportunity for industry to speak up in its behalf. I am assuming that since PCB's were brought up as an example of the type of substance this bill is supposed to prevent that Monsanto as sole producer in this country will be either invited or we may choose to ask to be invited (we don't know at this point just what is the proper approach here) to speak on the merits of retaining PCB's in transformers, capacitors and fire resistant heat transfer systems, non-food applications.

MONS 041643

I mention this bill because it is our opinion, and we could be wrong, that rather than act on Congressman Ryan's bill, which is specific toward PCB's, we suspect that the Toxic Substances Act will have in it provisions which will refer to such materials as PCB's.

We feel we have good technical data to justify our staying in the business for limited applications. But we cannot overlook the emotions that have set in. And believe me there are many and they are deep. It is difficult to combat emotions, as you know, and the references in the popular press to hazardous poisons and birth defects, which have not been substantiated, are most difficult to overcome. Although we talk about persistent versions of PCB and degradable versions of PCB I suspect, and this is a personal opinion, that there would be many who just discount this kind of information. This is a very real problem; in my opinion it is a difficult problem.

As a little more background let me describe what I understood from a meeting we held last week with representatives of the Food and Drug Administration. It is my personal opinion that the Food and Drug people are as conscientious as can be in trying to cope with the PCB problem. They are objective people trying to work with a minimum of data. I suspect they are as frustrated as any group of people can be as to what is the right way to go. There are tremendous pressures on the Food and Drug people today as well as the Department of Agriculture brought about by critics.

MONS 041644

These agencies are trying to objectively cope with the problem and at the same time trying to somehow live with these pressures that are being applied.

The FDA people really don't at this point in time have much information that will lead them to a regulation as to how much PCB should be tolerated in food. They have established some guidelines based on what little information they have from their own laboratories and the information that Monsanto has shared with them. The FDA will permit fish at 5 ppm on the marketplace; milk at .2 ppm or less; eggs .5 ppm; poultry (they have a double standard) 5 ppm in the fatty tissue and 5 ppm in the muscle tissue.

Another problem that is disturbing to the FDA, is the recycle paper problem. The cereal boxes, the cracker boxes, all of these boxes that are made from what is known as chipboard, are made from recycle paper. Fairly high levels of PCB's are being found in this recycle board. It probably comes from about three or four different sources. It may come from some ink application in the past, some adhesive application, some coating application, as well as the carbonless reproduction paper application. There have been some pilot studies made by the American Paper Institute to isolate the carbonless reproduction paper from the recycle batch. They still found PCB's in that batch. They are probably looking at maybe the second or third generation of recycle. And with the emphasis on recycle, I cannot see any way out of this dilemma except that there will be more and more PCB's in these cartons.

MONS 041645

A thought we must all keep in mind, too, is that we've got to live with the PCB's we introduced into the environment for the past 40 years. They have not disappeared overnight; they will not disappear overnight. We do not have any tests that tell us how long it will take. We can only make an educated guess and we might say they will be out there for another generation, 25 to 30 years yet. Hopefully, it will be a decreasing amount as time goes on.

Monsanto has conducted biodegradation tests on its products. We have three programs that are now active. One program we are conducting in our laboratories in Ruabon, Wales in which we are making what I would refer to as scientifically basic studies in terms of which isomers are most degradable and with what type of microbe. This is a little bit on the impractical side at this point in time. We have as a consultant, Professor Charles Evans of Bangor University in South Wales, who is a noted authority worldwide in this kind of activity. He has isolated at least three microbes that seem to thrive on polychlorinated biphenyls. These microbes he developed from soil that he obtained from his garden. What this tells us is that there are microbes out there in the environment that will eventually destroy these materials.

In the St. Louis area, we have two types of tests going. One is the use of river water with its normal biota in it, in which we introduced these polychlorinated biphenyls and look for the disappearance rate. It is a very quick and rather unsophisticated type of study. The other type of test is the one that simulates

MONS 041646

those conditions which are apt to be found in a normal municipal sewage treatment plant. It's an aerobic test using an activated sludge from a St. Louis waste treatment plant. As a standard, we use a soft detergent because it is well known to other laboratories. What we are doing, really is using our expertise that we established back in the days when the hard versus soft detergent controversy was quite common. And we are using these soft detergents that do degrade as our controls and comparing the PCB's to these controls. The studies so far show that there are isomers within each of these mixtures that do degrade. The lower the chlorine level, the faster they disappear, the higher the chlorine level the more resistant they are. Which only confirms what many of us had suspected. We were not too surprised by this data.

I will attempt to summarize ... I think we can conclude that PCB's are in the environment. There is no question about it. Many of these PCB's are manmade and were introduced to the environment because of our lack of understanding of what these materials can do to the environment. In this country Monsanto, as sole producer, has attempted to improve the situation by limiting the applications to which these materials are used. Studies today would indicate that these PCB's are not, and cannot be classified as highly toxic. There is still a lot of information that is needed to help us determine the long term effect on human beings. We feel that the properties of these materials make them, at least as of today, the most suitable material for use in transformers, capacitors and heat transfer systems. We also believe that under proper conditions we can control the amount of these

MONS 041647

that do enter the environment to the point where the adverse effects are not great and that the benefits we derive far outweigh the minor adverse effects that we might notice. Now there are many of us in the transformer and capacitor application that have made tremendous strides in controlling these materials. I suspect our objective is to further improve our ability to control this material. In my personal opinion the emotion that is now prevailing regarding PCB's is something that we must contend with. Whether we believe in it or not, there are many people that sincerely believe PCB's should be totally banned.

MONS 041648

DISCONTINUATION OF THERMINOL® FR SALES

* Would go to Vice Presidents/Business Group Directors only plus Specialty Products Group field sales/Regional Managers.

1. Q. *Why has Monsanto decided to discontinue Therminol® FR heat transfer fluid sales?

A. We have previously written to all Therminol® FR heat transfer fluid customers alerting them to the precautions necessary in handling and using these PCB-containing products. Earlier this year we stopped selling Therminol® FR fluids for new heat transfer fluid systems. We also discontinued sales of make-up Therminol® FR fluid to food-related applications and worked with these customers in converting FR fluid to non-PCB heat transfer liquids (e.g., Therminol 55 and Therminol 66). We have now decided to discontinue all Therminol® FR heat transfer fluid sales in the U.S.A. and Canada because there are serious problems associated with the possibility of accidental leakage of PCB from heat transfer systems.

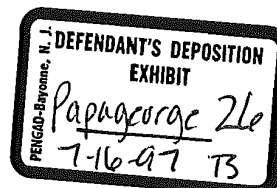
2. Q. *Who within Monsanto decided to discontinue Therminol® FR heat transfer fluid sales?

A. This decision was made by Monsanto's corporate management and affirmed by its Board of Directors at their monthly meeting in December, 1971.

3. Q. *Does this action mean Monsanto is getting out of the heat transfer business?

A. No. The sales ban applies only to the FR series of fluids (Therminol® FR-Lo Temp, Therminol® FR-O and Therminol® FR-1). The FR series is the only one that contains PCBs. All other Therminol® heat trans-

MONS 043488



fer fluids (Therminol® 55, 66, 77 and 88) are PCB-free.

4. Q. *Are you banning sales of all Therminol® fluids?

A. No. Not all Therminol® fluids contain PCBs. Therminol FR series (i.e., FR-Low Temp, FR-O and FR-1) are the only ones containing PCBs. All other Therminol® fluids (i.e., Therminol® 55, 66, 77 and 88) are PCB-free.

5. Q. *What replacements are available from Monsanto for Therminol® FR fluids?

A. The most likely Monsanto replacements are Therminol® 55 or 66. We must advise you that none of Monsanto's remaining Therminol® heat transfer fluids are fire resistant. We suggest you work closely with your insurance company in converting from Therminol® FR fluids so that you make a carefully considered informed decision. As stated in our letter of December 15, 1971, Monsanto has a team of engineers available to be of assistance to you in making your decision. They may be contacted by telephone at (314) 694-2514 or by writing Dr. Cumming Paton, Monsanto Company, P.O. Box 14617, St. Louis, Missouri 63178.

6. Q. *What other fire resistant heat transfer fluids are available from Monsanto?

A. Unfortunately we have none available and will not have one available in the foreseeable future.

7. Q. *What other fire-resistant heat transfer fluids are available in the U.S.A. or Canada?

MONS 043489

- A. The only fire resistant heat transfer media we know of are high pressure water and molten salts. Both of these systems have disadvantages which may rule them out as replacements for many existing Therminol® FR systems.
8. Q. *Could I obtain PCB fluids outside the U.S.A. or Canada?
- A. PCBs are manufactured in France, West Germany, Italy and Japan. The decision on imports is yours to make. We would suggest, however, you consider such a course of action very carefully.
9. Q. Will Monsanto's ban on PCBs for sale in heat transfer systems apply world-wide?
- A. Yes, as soon as the decision can be implemented.
10. Q. Will a world-wide ban on Therminol FR sales go into effect immediately?
- A. As promptly as it can be implemented.
11. Q. Have any of your competitors in PCB manufacture announced a similar ban?
- A. Not to our knowledge. However, we believe they are considering restrictions on PCB sales. Bayer has already made an announcement to this effect. Furthermore, certain European countries (e.g., Sweden) have taken action limiting the imports of PCBs. Other countries could well follow suit.
12. Q. *Why has Monsanto acted so precipitately on Therminol® FR sales?
- A. We do not consider our action precipitous.

MONS 043490

13. Q. Why is Monsanto giving overseas customers longer to convert than its U.S.A. and Canadian customers?
- A. Implementing a decision of this kind on an international basis takes time.
14. Q. This latest policy on Therminol® FR sales is not consistent with Monsanto's previous differentiation between "open" and "closed" PCB systems. Why is Monsanto changing its policy.
- A. We are concerned about accidental leakage over which we have no control. Our policy has not changed.
15. Q. By banning Therminol® FR sales, is Monsanto admitting that PCBs are the toxic, dangerous chemicals that many scientists, ecologists and writers have been suggesting for over two years?
- A. The extent to which PCBs are toxic and dangerous is a relative and complex matter. We believe this action and our previous actions concerning PCBs have been reasonable and rational. We believe we have acted as reasonably as any manufacturer could on learning an increasing amount of previously unknown information about one of its products.
16. Q. The FDA recently stated (FDA Press Conference September 29, 1971) that the alarm over PCBs is greater than the facts justify. FDA also rejected an outright ban on PCBs as some critics have called for. The FDA does not believe PCBs are an imminent hazard. In view of these FDA statements why has Monsanto acted so precipitately in apparent contradiction of FDA?

MONS 043491

A. We respect the opinion of FDA and are aware of it. The FDA, however, is not a corporation engaged in the manufacture and sale of products, and its opinion on this subject does not govern our decision. Again, we do not feel we have acted precipitously.

17. Q.* We do not dispute Monsanto's reason for its decision on Therminol® FR fluids; our strong criticism of Monsanto concerns the lack of warning by Monsanto that they were going to ban Therminol® FR sales. Why were we given no warning.

A. Our previous communications should have alerted you to the possibility of this decision on our part. We believe warnings were given. We communicated our decision that no new heat transfer systems would be sold Therminol® FR. Sale of Therminol® FR to food-related applications was discontinued. In addition, we have encouraged remaining customers to consider converting to a non-Therminol® FR fluid either before or at the time for the next "make-up".

18. Q.* We believe it is impossible to convert all Therminol® FR systems in the U.S.A. and Canada on the day your decision was received. That means heat transfer systems are still operating on FR fluid; why can't we have another drum or two to last until such time as we can shut down our plant for conversion?

MONS 043492

A. Monsanto believes that lee-way in the matter of filling Therminol[®] FR orders after its decision was communicated could lead to stock-piling, which we believe is unwise under the present circumstances. One of the key reasons for establishing a team of engineers at Monsanto is to give advice and assistance to aid customers in arriving at informed decisions on how to handle such situations. Assistance may be obtained by calling (314) 694-2514 at Monsanto's St. Louis headquarters.

19. Q. From recent PCB production figures given out by Monsanto, there are other applications besides heat transfer for PCBs. What action has Monsanto taken on PCBs in these other applications?

A. Simply enumerate the actions.

20. Q. We see that dielectric applications are by far the biggest user of PCBs. Shouldn't they be the ones to be shut down?

A. Based on the information available to us at this time we believe the risk of accidental escape from this use is slight. Our opinion on this may change.

21. Q. I buy PCB for both dielectric and heat transfer uses. Why can I get one but not the other?

A. Because, in our opinion, the risk of accidental leakage and possible resulting contamination is less in one use than in the other.

MONS 043493

22. Q.* How long will the engineering team be available to help on conversions?

A. We would hope most customers will have converted to non-FR fluids in the first four months of 1972. However, the engineering team supplements the ongoing team of Monsanto heat transfer fluid specialists. Monsanto's heat transfer fluid specialists are always available for reasonable periods to assist customers.

23. Q. Is there any possibility Monsanto's replacement heat transfer fluids may be discontinued as abruptly as Therminol® FR?

A. We do not consider our decision abrupt. We have no present plans for discontinuing sales of replacement fluids, but our customers should anticipate that we will react responsibly to new information about our products as we have with PCBs.

24. Q.* What evidence do you have that Therminol 55 and 66 will not give similar problems to the ones that have arisen with Therminol® FR?

A. We will send you bulletins on Therminol 55 or 66 which contain relevant data on this subject.

25. Q. What is the attitude of FDA and USDA on Therminol® 55 and 66 as replacements for Therminol® FR?

A.

MONS 043494

26. Q.* Your letter of December 15, 1971 states that refunds on returned Therminol® FR fluids will not be given after March 1, 1972.

Does this mean I must convert to another fluid by then?

A. The decision on when and to what to convert is yours. The re-fund policy applies only to unopened drums of Therminol® FR you may be carrying as inventory in your warehouse.

27. Q. I just filled my Therminol® FR system in early 1971. The fluid is in excellent condition and could probably be reclaimed by Findett to be as good as new. Will you allow me credit if I return the drained fluid by March 1, 1972?

A. No.

28. Q. Are you banning Therminol® FR fluids because Monsanto admits liability in the Holly Farms lawsuit?

A. We admit no liability in the Holly Farms lawsuit. We point out that Holly Farms sued the user of PCB heat transfer fluid as well as Monsanto.

29. Q. I have read of the Holly Farms lawsuit against Monsanto. Have you other lawsuits pending on PCBs. If any, what are they about?

A. Questions concerning lawsuits should be directed to our Law Dept.

30. Q. Does Monsanto know of any cases where plant employees have suffered illness or harm because of PCBs and Therminol® FR in particular?

A.

MONS 043495

31. Q. What should I tell my employees if they ask why we are switching from Therminol FR to a more hazardous fluid as far as fire safety is concerned?
- A. The decision is yours. Perhaps you might indicate that the material is no longer available.
32. Q. Does Monsanto consider PCB to be a toxic and dangerous substance to humans and wildlife?
- A. The question is not susceptible of a simple yes or no answer. We can refer you to scientific information from which you may draw your own conclusions.
33. Q. Monsanto has made great play in its press statements on the safety aspects of PCBs with respect to their use in dielectrics. In heat transfer, we chose Therminol® FR solely on the grounds of safety where we could protect the lives of our employees, neighboring citizens and valuable property. Why does Monsanto discriminate on safety? Why use safety as an excuse for continued PCB sales in one area and not in another?
- A. Because, in our opinion, the risk of accidental leakage and possible resulting contamination is less in one use than in the other.
34. Q. Was any pressure put on Monsanto by government agencies, environmental groups or other quasi-official groups to ban Therminol® sales?
- A. The decision was the independent internal decision of the top management of this company.

MONS 043496

Advised

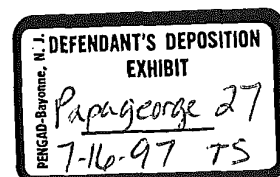
SALES MEETING

Tuesday, April 24, 1971

8:30 - 9:00	Introduction - Hydraulics and Lubricants	CLB
9:00 - 10:00	Pydraul Reformulation	
	A. Status	DWF
	B. New literature	PZ
	C. Comparison of Old vs. New	JHD
	D. Promotion of Reformulations	JHD
10:15 - 11:00	Santosafe W/O	
	A. Business Review	CLB
	B. Future Plans	JHD
	C. Pricing Policy	JHD
	D. Low Cost W/O	
11:00 - 12:00	Pydraul/Santosafe Competition	
	A. Competitive Oil - P.E.'s	JHD
	1. Technical review	
	2. Marketing approach: Pricing	
	B. Competitive Water/Glycols	
	1. Technical review	
	2. Marketing approach: Pricing	
1:00 - 1:45	Environment/Pollution	JHD/WP
	A. Immediate Situation	
	B. Monsanto vs. Competition	
	C. Possible Future Action - Defense	
1:45 - 3:00	Coolanol: Products/Marketing Plan	REH
	Santovac: Products/Marketing Plan	
	Turbine Lubes: Products/Marketing Plan	
	OS - MCS Products	
3:15 - 5:00	Skydrol	FHL
	A. Products	
	B. Competition	
	C. Marketing Plan	
	1. Goals	
	2. Accounts	

REY 000359

REDACTED



8:00 - 10:00

Pydraul/Santosafe Major Potential
Accounts - Status and Goals

1.

2.

3.

4.

5.

6. Reynolds Metals
Sheffield, Massena, McCook,
Richmond, Longview

7.

REY 000360

August 16, 1972

Mr. B. P. Collins
Reynolds Metals Company
10th and Byrd Streets
Richmond, Virginia 23219

Dear Mr. Collins:

In response to your telephone request I am forwarding under separate cover samples of Aroclor 1242 and Aroclor 1254.

If I can be of further service please let me know.

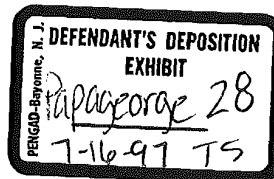
Sincerely,

W. B. Papageorge
Manager
Environmental Protection

WBP/bt

1242 } S.N. 1392
17-1254 }

REY 000403



Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63188
Phone: (314) 684-1000

April, 1972

Dear Sir:

Since early 1970 we have been advising your company of significant developments relating to the polychlorinated biphenyl (PCB) environmental situation.

As you know, many pollution control agencies conduct monitoring programs to evaluate the presence and impact of many materials on the environment. Some of these programs include PCB.

Recently a representative of a governmental pollution control agency contacted Monsanto requesting information concerning PCB sales. Specifically, he asked for names and addresses of PCB customers in his area, with the quantities of PCB product sold to each. He stated that this information was being requested because significant amounts of PCB were being detected in the discharge from sewage treatment facilities in his area.

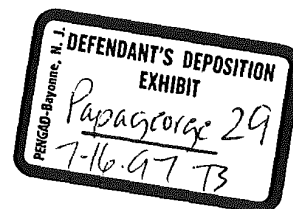
He was informed that Monsanto considers information of this type confidential and, therefore, does not disclose it outside the Company. He subsequently informed us that the request for information was being sent to the local federal district attorney for appropriate action.

As we have pointed out on numerous occasions to representatives of government and of private groups, Monsanto has long had a policy, which it continues to follow, of treating information concerning its customers as confidential information. However, you should be aware that, because of governmental or judicial orders or requirements or because of a change in circumstances resulting from the unique nature of the PCB problem, Monsanto may at some future date be obligated to disclose such information to qualified persons.

REY 000062

34

a unit of Monsanto Company



WATER_PCB-SD0000064259

- 2 -

We wish to strongly re-emphasize with you the importance of avoiding direct or accidental PCB contamination of feed, food and packaging material and of preventing PCB's from escaping into the environment. We direct your attention to the recent FDA notice of proposed rule making on PCB's published in the Federal Register, Vol. 37, No. 54, pp 5705 and following, dated March 18, 1972.

If PCB's are still present at your locations you are urged to thoroughly review your procedures and inspect your facilities to insure that extreme care is taken in the handling, use, storage, and disposal of these materials.

Sincerely,



W. B. Papageorge
Manager
Environmental Protection

REY 000063

Plant Manager
Reynolds Metals
4th & Canal
Richmond, Va. 23218

Plant Manager
Reynolds Metals Co.
South Grasse River Rd.
Messena, N.Y. 13662

REY 000065

Office of the President
Reynolds Metals Company
6601 Broad Street
Richmond, Virginia 23218

Plant Manager
Reynolds International
P. O. Box 27003
Richmond, Virginia 23261

Plant Manager
Reynolds Metals Company
P. O. Box 500
Massena, New York

REY 000064

FORM NO 7769

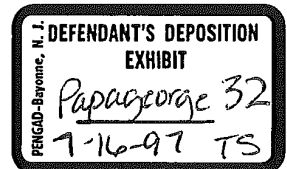
SALES SUMMARY

2 A	10 4590 009 PYDEAUL F9	21 SALESMAN'S SALES BY CUSTOMER A GENERAL DISTRICT B ACCOUNTS DIVISION C PLASTIC'S DIVISION D PLASTIC'S DIVISION	22 PRODUCT SALES BY CUSTOMER A TOTAL PRODUCT SALES B NUMBER ALLIANCE - LANE	23 PRODUCT SALES BY CUSTOMER A GENERAL DISTRICT B ACCOUNTS DIVISION C PLASTIC'S DIVISION D PLASTIC'S DIVISION	24 SALES THIS YEAR TO DATE A ALL SALES B ALL SALES C ALL SALES D ALL SALES	25 MONTH DEC	26 YEAR 59	27 PAGE NO 457
		SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS		TOTAL SALES LAST YEAR POUNDS DOLLARS		

617466 09 01 REYNOLD MET CO MASSENA NY

7.080 2.344

REY 000001



FORM NO 7760

SALES SUMMARY

2 A	1 SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL C. RUBBER ACCOUNTS D. PLASTICS DIVISION E. CHEMICAL DISTRICT	2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	3 TENDRICE PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL C. RUBBER ACCOUNTS D. PLASTICS DIVISION E. CHEMICAL DISTRICT	4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL C. RUBBER ACCOUNTS ONLY	MONTH DEC	YEAR 59	PAGE NO 400
	SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS		TOTAL SALES LAST YEAR POUNDS DOLLARS		

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617466 09 01 REYNOLD MET CO MASSENA NY

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510

REY 000002

FORM NO 7760

SALES SUMMARY

2 A	1 SALESMAN'S SALES BY CUSTOMER		22 PRODUCT SALES BY CUSTOMER		3 DISTRICT PRODUCT SALES BY CUSTOMER		4 CUSTOMER SALES BY PRODUCTS		MONTH	YEAR	PAGE NO
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11 1040 260 AROCLOR DIST 1248						SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR	
						POUNDS DOLLARS		POUNDS DOLLARS		POUNDS DOLLARS	

617466 09 01 REYNOLD MET CO MASSENA NY

144,100

23,116

REV 000003

FORM 3 910

SALES SUMMARY — PRODUCTS BY MONTH (THOUSANDS)

ORG 2 A			#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY		#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY		MONTH			YEAR			PAGE NO.	
											DEC			1960			44B	
DATE	SALES FROM RUBBER COP.	NAME OF CUSTOMER OR PRODUCT	LAST YEAR SALES	SALES FORECAST FOR CURRENT YEAR	SALES CURRENT YEAR TO DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG.	SEPT	OCT	NOV	DEC	
		10 4590 009 HYDRAUL F9																

REY 000004

p9011 0617466 REYNOLD MET CO MASSENA NY

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FORM 5910

SALES SUMMARY — PRODUCTS BY MONTH (THOUSANDS)

ORG 2 A			B1 SALESMEN'S SALES BY CUSTOMER A GENERAL DISTRICT B RUBBER ACCOUNTS		B2 PRODUCT SALES BY CUSTOMER A TOTAL ORGANIC SALES B RUBBER ACCOUNTS ONLY		B3 DISTRICT PRODUCT SALES BY CUSTOMER A GENERAL DISTRICT B RUBBER ACCOUNTS		B4 CUSTOMER SALES BY PRODUCTS A ALL ORGANIC ACCOUNTS B RUBBER ACCOUNTS ONLY		MONTH		YEAR		PAGE NO.							
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REY 000005

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SALES SUMMARY — MONTHS BY MONTH (THOUSANDS)

ORG 2 A			#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY	MONTH			YEAR				PAGE NO.				
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REV 000006

FORM 5 910

SALES SUMMARY — POWERS BY MONTH (THOUSANDS)

FIRELINE		#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY	MONTH			YEAR			PAGE NO					
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DATE	SALES FROM RUBBER	NAME OF CUSTOMER OR PRODUCT	LAST YEAR SALES	SALES FORECAST FOR CURRENT YEAR	SALES CURRENT YEAR TO DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC

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REY 000007

1110402660	Araclar DIST 1248																
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FORM NO 7760

SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER		#2 PRODUCT SALES BY CUSTOMER		#3 DISTRICT PRODUCT SALES BY CUSTOMER		#4 CUSTOMER SALES BY PRODUCTS		MONTH	YEAR	PAGE NO
	A GENERAL DISTRICT B AGRICULTURAL CHEMICAL DISTRICT	C RUBBER ACCOUNTS D PLASTICS DIVISION	A TOTAL ORGANIC SALES B RUBBER ACCOUNTS ONLY	A GENERAL DISTRICT B AGRICULTURAL CHEMICAL DISTRICT	C RUBBER ACCOUNTS D PLASTICS DIVISION	A ALL ORGANIC ACCOUNTS B AGRICULTURAL EXCEPT IN COLUMBIA UNIT C RUBBER ACCOUNTS ONLY					
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					SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR		
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REV 000008

FORM 5 910

SALES SUMMARY — POUNDS BY MONTH (THOUSANDS)

DIRECT M2		11 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		12 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY		13 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		14 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY		MONTH		YEAR		PAGE NO.					
										DECEMBER		1964		470					
DATE	SALES PERSON NAME	NAME OF CUSTOMER OR PRODUCT				LAST YEAR SALES	SALES YEAR TO DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
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REY 000009

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FORM 5710

SALES SUMMARY — POUNDS BY MONTH (THOUSANDS)

DIRECT #2		#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY		#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY		MONTH DECEMBER		YEAR 1964		PAGE TWO 475					
DATE	SHEET NO.	PROD. NO.	NAME OF CUSTOMER OR PRODUCT THERMINOL FR-2			LAST YEAR SALES	THIS YEAR SALES	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC

1005 AB17466 REYNOLD MET CO MASSENA NY

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REY 000010

11 1040 265 THERMINOL FR-2

FORM 5-60

SALES SUMMARY — PERIODS BY MONTH (THOUSANDS)

DIRECT # 2		1. SALESMAN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS		2. PROMOTED SALES BY CUSTOMER A. TOTAL CREDITABLE SALES B. RUBBER ACCOUNTS ONLY		3. EXTENDED PROMOTED SALES BY CUSTOMER A. GENERAL DISTRICT B. RUBBER ACCOUNTS					4. CUSTOMER SALES BY PRODUCTS A. ALL CREDITABLE PRODUCTS B. RUBBER ACCOUNTS ONLY					MONTH DECEMBER			YEAR 1965		PAGE NO. 463	
DATE	TIME	NAME OF CUSTOMER OR PRODUCT		LAST YEAR SALES	THIS YEAR SALES	THIS YEAR SALES	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC				
		# 1040 260 Anacolor Dist. - 1246																				

1005 0617966 REYNOLD MET CO MASSENA N 0009

REV 000011

FORM 1010

SALES SUMMARY — POUNDS BY MONTH (THOUSANDS)

DIRECT # 2		1. SALESMEN'S SALES BY CUSTOMER A. GENERAL INQUIRY B. RUBBER ACCOUNTS		2. PRINCIPAL SALES BY CUSTOMER A. TOTAL OUTSTANDING SALES B. RUBBER ACCOUNTS ONLY		3. OUTSTANDING SALES BY CUSTOMER A. GENERAL INQUIRY B. RUBBER ACCOUNTS ONLY		4. RUBBER SALES BY PRINCIPALS A. ALL RUBBER ACCOUNTS B. RUBBER ACCOUNTS ONLY		MONTHS												TOTAL
		NAME OF CUSTOMER OR PRODUCT		LAST YEAR SALES		THIS YEAR SALES				DECEMBER 1965												468
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REV 000012

SALES SUMMARY - PG 403 BY MONTH (THOUSANDS)

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REV 000013

1005 AB17466 REYNOLDS MET MASSENA NY

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FORM NO. 7760

SALES SUMMARY

ORGANIC #2	B-1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL DISTRICT D. PLASTICS DIVISION		B-2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS UNIT		B-3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL DISTRICT D. PLASTICS DIVISION		B-4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS UNIT C. RUBBER ACCOUNTS UNIT		MONTH DEC.	YEAR 1966	PAGE NO. 598
	11 1040 265 THERMINOL FR-2		SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS		TOTAL SALES LAST YEAR POUNDS DOLLARS				

10 37 A 617466	REYNOLDS MET MASSENA NY	6,000	1,680	30,000	8,400	24,000	6,720
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REY 000014

SALES SUMMARY

ORGANIC #2	21 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL C. RUBBER ACCOUNTS D. PLASTIC DIVISION E. CHEMICAL DISTRICT	22 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	23 INSTANT PRODUCT SALES BY CUSTOMER A. AGRICULTURAL B. CHEMICAL DISTRICT C. RUBBER ACCOUNTS D. PLASTIC DIVISION E. GENERAL DISTRICT	24 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. RUBBER ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY	DATE DEC.	YEAR 1966	PAGE NO. 665
	SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS		TOTAL SALES LAST YEAR POUNDS DOLLARS		

11 4392 188 PYRAMAL 150 186

10 37 6 617466 REYNOLDS MET MASSENA NY

1,076 275 1,076 275

REV 000015

SALES SUMMARY

ORGANIC #	1. SALES BY CUSTOMER		2. PRODUCT SALES BY CUSTOMER		3. CUSTOMER SALES BY PRODUCT		MONTH	YEAR	PAGE NO.
	A. TOTAL SALES	B. RUBBER ACCOUNTS	A. TOTAL ORGANIC SALES	B. RUBBER ACCOUNTS	A. ALL ORGANIC ACCOUNTS	B. RUBBER ACCOUNTS			
11 4595 200 PYDRAUL A 200							DEC.	1966	610
10 37 A 617466									
REYNOLDS MET MASSENA NY									

REV 000006

FORM 5-910
REV 11-66

SALES SUMMARY — POINTS BY MONTH (THOUSANDS)

ORGANIC #4			#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS	MONTH			YEAR					TOTAL			
							DEC.	1967					522					
DATE	SALES	PROD	NAME OF CUSTOMER OR PRODUCT	LAST YEAR SALES	LAST YEAR SALES THIS YEAR	LAST YEAR SALES THIS YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC

10/37	A	617466	REYNOLDS MET MASSENA NY	12	30	12	6			6								
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REY 000017

			11 1040268	Thermal FR-2														
--	--	--	------------	--------------	--	--	--	--	--	--	--	--	--	--	--	--	--	--

FORM 5010
REV. 11-66

SALES SUMMARY — MONTHS BY MONTH (THOUSANDS)

ORGANIC 02			#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS					MONTHS			YEAR			PAGE NO.	
			NAME OF CUSTOMER OR PRODUCT	LAST YEAR	THIS YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	
																		528

01/002 100 PYRAMAL 105

REV 000018

12/31/67	A	617400	REYNOLDS MET	MASSENA NY	1	5					1				2		2
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SALES SUMMARY — POINTS BY MONTH (THOUSANDS)

ORGANIC #2		#1 SALESMAN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS	MONTH DEC.			YEAR 1967			PAGE NO 533						
DATE	LAST YEAR SALES	NAME OF CUSTOMER OR PRODUCT			SALES FOR LAST YEAR	SALES CURRENT YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
		11-4595 300 PYRENEAL A 200																

10/37 A 617466 REYNOLDS MET MASSENA NY 12 14 12 10 2 3 3 1 1 1

REV 000019

11 4595 200 Pyreneal A 200

FORM 3-70
REV 11/66

SALES SUMMARY — FORMED BY MONTH (THOUSANDS)

ORGANIC 84		#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS					MONTH			YEAR		PAGE NOS		
										DEC.	1967				720		
NAME	SALES NO.	NAME OF CUSTOMER OR PRODUCT	LAST YEAR SALES	SALES CUMULATIVE FOR CURRENT YEAR	SALES CUMULATIVE YEAR TO DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG.	SEPT	OCT	NOV	DEC
		10 1050 300 TRANSFORMER PYRALOL A1363B															

10/31 A 617466 REYNOLDS MET MASSENA NY 2 2

REV 000020

10 1050 300 TRANS PYRALOL A1363B

SALES SUMMARY

UN. GATEL	#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRIBUTOR SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS	DATE	YEAR	PAGE NO.
					DEC.	1968	653
11 1040 265 Therminol FR-2		SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR	
		POUNDS DOLLARS		POUNDS DOLLARS		POUNDS DOLLARS	

18 37 A	1960	NY	MASSACHUSETTS	5			6,000	1,680	6,000	1,680
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REF 000021

SALES SUMMARY

1. NAME	2. SALESMAN'S SALES BY CUSTOMER	3. PRODUCT SALES BY CUSTOMER	4. FINEST PRODUCT SALES BY CUSTOMER	5. CUSTOMER SALES BY PRODUCTS	6. MONTH	7. YEAR	8. PAGE NO.
11 4592 135 <i>Pyram 135</i>					DEC.	1968	662
			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR
			POUNDS DOLLARS		POUNDS DOLLARS		POUNDS DOLLARS

13 37 A 617400	14 YACHTS INC MASSENA NY			5,146	2,433	5,380	1,419
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REV 000022

FORM NO. 774-B
REV. 3-67

SALES SUMMARY

ORGANIC #	#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS	MONTH	YEAR	PAGE NO.
					DEC.	1968	667
11 4595 200 PYRBAUL A 200			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR
			POUNDS DOLLARS		POUNDS DOLLARS		POUNDS DOLLARS

13 37 J 617400	REYNOLDS MLT MASSENA NY 10		5,805	1,603	9,675	2,602
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REV 000023

FORM NO 7768
Rev 3-67

SALES SUMMARY

ORGANIZATION	#1 SALESMEN'S SALES BY CUSTOMER	#2 PRODUCT SALES BY CUSTOMER	#3 DISTRICT PRODUCT SALES BY CUSTOMER	#4 CUSTOMER SALES BY PRODUCTS	MONTH	YEAR	PAGE NO.
					DEC	1968	933
16 1050 300 TRANS PYRANO/ A13838			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR
			POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS

13 37 A 6174cc	REYNOLDS MET MASSACHUSETTS					4,725	891
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REV 000024

1969

PAGE 22

NAME OR PRODUCT/CUSTOMER	QUANTITY	LAST YEAR SALES	SALES/COM	SALES	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	1968 TOTAL
THERMINOL FR-2																	1040-265-10

REYNOLDS METALS MESSENA NY		6.00		6.00													13361190
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REY 000025

1969

PAGE 66

NAME OR PROJECT CUSTOMER	TEST YEAR	SALES YEAR	SALES YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
HYDRAL A 200																4,500 - 2,000

KEYNOLDS METALS NESSENA NY	5.81															
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REV 000026

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1969

PAGE 12

SALES AREA	TEAM OR PRODUCT/CUSTOMER	ESTABLISHED	LAST YEAR SALES	SALES GOAL FOR CURRENT YEAR	SALES CURRENT YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
	HYDRAUL 125	1968	125															

	REYNOLDS METALS MESSENA NY		9.15	12.0														
--	----------------------------	--	------	------	--	--	--	--	--	--	--	--	--	--	--	--	--	--

REY 000027

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REPORT 01476-A
01/14/71

ORGANIC DIV - FUNCTIONAL FLUIDS
NO. 4 CUSTOMER/PRODUCT SALES REPORT FOR DEC 1970
-IN ACTUAL POUNDS AND DOLLARS-

PAGE 15

TOTAL MONTH SALES	Y-T-D	SALES	TOTAL LAST YEAR SALES	TOTAL YEAR	CUST ID
POUNDS DOLLARS	POUNDS	DOLLARS	POUNDS DOLLARS	GOAL LBS	MAJOR-CRD-CP

REYNOLDS METALS MESSENA NY
1052 TERMINAL 1A-2

6,000	1,800	6,000	1,680	AR 617466 6,000	10067790 104Q-265-10
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REV 000028

REPORT 81476-A

01/14/71

ORGANIC DIV - FUNCTIONAL FLUIDS
NO. 4 CUSTOMER/PRODUCT SALES REPORT FOR DEC 1970
-IN ACTUAL POUNDS AND DOLLARS-

PAGE 223

TOTAL MONTH SALES	Y-T-D	SALES	TOTAL LAST YEAR SALES	TOTAL YEAR	CUST ID
POUNDS DOLLARS	POUNDS DOLLARS	POUNDS DOLLARS	POUNDS DOLLARS	GOAL LBS	MA-M-GRD-UP

REV 000029

REYNOLDS METALS MESSENA NY
1130 PYRAUL 135

23,672

6,362

12,912

3,499

AR 617466

10067790
4592-135-11

REPORT B1476-A

ORGANIC DIV - FUNCTIONAL FLUIDS
NO. 4 CUSTOMER/PRODUCT SALES REPORT FOR DEC 1970
-IN ACTUAL POUNDS AND DOLLARS-

PAGE 423

01/14/71

TOTAL MONTH SALES		Y-T-D POUNDS	SALES DOLLARS	TOTAL LAST YEAR SALES		TOTAL YEAR GOAL LBS	CUST ID MAJR-GRU-CP
POUNDS	DOLLARS			POUNDS	DOLLARS		

REYNOLDS METALS MESSENA NY
1637 TRANSFORM PYRAMUL A13030

3,375

670

3,375

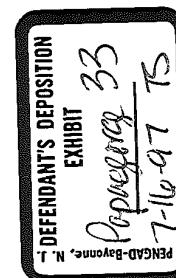
670

AR 617466

10067790

1050-300-16

REY 000030



NEW YORK
PCB CONTENT
1968 - 1969

M POUNDS		
<u>1968</u>	<u>1969</u>	<u>Total</u>
0.9		0.9
	0.1	0.1
0.6		0.6
0.6		0.6
0.3	0.1	0.4
3.3	2.4	5.7
0.6		0.6
1.2		1.2
0.6		0.6

REY 000262

REDACTED

NEW YORK

- 2 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
41.9	40.6	82.5
0.2	0.9	1.1
	0.1	0.1
0.1		0.1
41.3	6.7	48.0
0.1		0.1
10.8		10.8
	0.6	0.6
1.2	2.1	3.3
	0.2	0.2
16.8		16.8
	3.6	3.6

REV 000263

NEW YORK

- 3 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
0.2	0.1	0.3
	0.2	0.2
16.8	4.8	21.6
0.6		0.6
	1.2	1.2
0.7		0.7
	0.4	0.4
28.5	31.8	60.3
<u>13.8</u>	<u>8.4</u>	<u>22.2</u>
42.3	40.6	82.9
2.4		2.4
0.1	0.5	0.6
	1.8	1.8

REY 000264

NEW YORK

- 4 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
10.2	1.2	11.4
3.3	1.2	4.5
	<u>3.0</u>	<u>3.0</u>
<u>13.5</u>	5.4	18.9
0.5		0.5
	0.1	0.1
0.3		0.3
	5.8	5.8
<u>123.6</u>	<u>177.3</u>	<u>300.9</u>
123.6	183.1	306.7
5.5	1.1	6.6
0.2	0.1	0.3
<u>2.0</u>	<u>0.2</u>	<u>2.2</u>
7.7	1.4	9.1
	103.5	103.5
0.1		0.1
2.1		2.1

REY 000265

NEW YORK

- 5 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
	2.4	2.4
0.2		0.2
0.2	0.2	0.4
0.3	0.8	1.1
0.3	0.1	0.4
2.9	0.2	3.1
	<u>1.4</u>	<u>1.4</u>
2.9	1.6	4.5
0.1		0.1
	0.2	0.2
	1.8	1.8
1.6	1.8	3.6
0.6	0.6	1.2

REY 000266

NEW YORK

- 6 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
0.2		0.2
6.3	7.9	14.2
0.7	0.5	1.2
0.2	0.9	1.1
<u>21.6</u>	<u>26.4</u>	<u>48.0</u>
21.8	27.3	49.1

REV 000267

	5.0	5.0
0.7	1.8	2.5
0.6	1.2	1.8
0.1		0.1
1.8	1.8	3.6
4.3	3.8	8.1

NEW YORK

- 7 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
8.4		8.4
	3.0	3.0
150.0	108.0	258.0
	0.3	0.3
<u>0.3</u>	<u>0.3</u>	<u>0.3</u>
0.3	0.3	0.6
	1.0	1.0
	2.1	2.1
	0.2	0.2
0.6		0.6
	33.5	33.5
89.7	161.0	250.7
39.4		39.4

REV 000268

NEW YORK

- 8 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
<u>5.2</u> 134.3	<u>6.5</u> 201.0	<u>11.7</u> 335.3
0.1		0.1
0.1		0.1
	2.4	2.4
	0.2	0.2
1.1	0.2	1.3
36.0	34.8	70.8
0.5	0.5	1.0
0.5	0.4	0.9
	0.3	0.3
1.2	3.0	4.2

REY 000269

NEW YORK

- 9 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
0.1	0.1	0.2
	<u>0.6</u>	<u>0.6</u>
<u>0.1</u>	0.7	0.8
	3.0	3.0
1.2	1.2	2.4
7.6		7.6
61.3	92.6	153.9
0.1		0.1
0.1	4.9	5.0
<u>0.1</u>	<u>0.9</u>	<u>1.0</u>
0.2	5.8	6.0
	3.1	3.1
0.1		0.1
3.6	10.8	14.4

REY 000270

NEW YORK

- 10 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
	0.6	0.6
0.1		0.1
0.1	0.2	0.3
1.1	0.1	1.2
	0.2	0.2
	11.4	11.4
0.1	0.1	0.2
	0.1	0.1
	2.8	2.8
0.3	0.3	0.6

REY 000271

NEW YORK

- 11 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
0.4		0.4
1.1		1.1
0.8		0.8
0.6	2.4	3.0
284.9	242.2	527.1
4.2		4.2
2.4		2.4
8.4	4.8	13.2
11.0	9.0	20.0
	1.3	1.3
0.5	0.3	0.8

REY 000272

NEW YORK

- 12 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
	0.1	0.1
0.1	0.1	0.2
	0.1	0.1
0.6	0.6	1.2
	0.2	0.2
2.8	1.2	4.0
0.1		0.1
113.4	85.3	198.7
	0.1	0.1
2.4		2.4
<u>0.9</u>		<u>0.9</u>
3.3		3.3
0.2		0.2

REV 000273

NEW YORK

- 13 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
	1.2	1.2
0.3		0.3
9.1		9.1
1.2	6.0	7.2
15.2		15.2
0.1		0.1
0.6		0.6
	0.1	0.1
3.1		3.1
0.3		0.3
	7.2	7.2

REY 000274

NEW YORK

- 14 -

	<u>1968</u>	<u>1969</u>	<u>Total</u>
	0.4	0.4	0.8
Reynolds Metal			
Messena	16.0	11.9	27.9
		0.6	0.6
		2.4	2.4
	0.5	0.2	0.7
	0.1		0.1
	0.4		0.4
	<u>0.6</u>		<u>0.6</u>
Sub-total	1.0		1.0
	3.6	6.0	9.6
	<u>0.1</u>		<u>0.1</u>
Sub-total	3.7	6.0	9.7
		9.6	9.6
	16.2	1.8	18.0

REV 000275

ITEM 5 -- ATTACHMENT B

-Continued-

1971 PCB RETURNS

Vendor

Pounds

914

5,000

1971 TOTAL

1,149,645 lbs.

1,149
645

REY 000291



AN INDIRECT AROCLOR HEATER for UNIT CHEMICAL OPERATIONS

Monsanto Technical Bulletin No. P-130

September, 1949

Monsanto Chemical Company

St. Louis (4), Missouri

AN INDIRECT AROCLOR HEATER FOR
UNIT CHEMICAL OPERATIONS

Monsanto Technical Bulletin No. P-130
September, 1949

Aroclor® 1248 (chlorinated biphenyl) is an ideal nonflammable liquid phase heat-transfer medium for temperatures up to 300°C.

This bulletin describes the physical properties of Aroclor 1248 and illustrates the design and operation of heaters that have been used successfully by Monsanto plants during the past seven years. The units described are gas fired and the capacities are in the range of 200,000 to 400,000 B.t.u. per hour.

Other larger commercial installations using Aroclor 1248 have capacities ranging up to 2,000,000 B.t.u. per hour.

Also small electrically heated stationary and portable units with capacities around 40,000 B.t.u. per hour, using Aroclor 1248 as the heat-transfer medium, are in service.

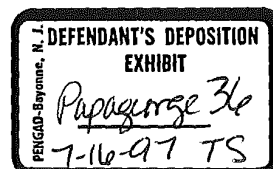
Several leading manufacturers of heating equipment are in position to build or offer Aroclor heating units to meet specific requirements.

*Reg. U. S. Pat. Office

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Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

REY 001424



WATER_PCB-SD0000064308

An Indirect Aroclor Heater for Unit Chemical Operations

MEADE MCARDLE¹, L. C. GARRETT, AND P. G. BENIGNUS²

Monsanto Chemical Company, Anniston, Ala.

The characteristics of Aroclor 1248 indicate that it is an ideal liquid phase heat-exchange medium for temperatures up to 300° C. This article discusses its properties and illustrates the design and operation of heaters that have been used successfully by Monsanto plants during the past seven years.

IN CERTAIN manufacturing processes of the Monsanto Chemical Company, it was necessary to employ a noncombustible heat-transfer medium at pressures of 80 pounds per square inch or less and temperatures up to 300° C. The following general properties of a heat-exchange medium were required:

- Freedom from fire hazards.
- Viscosities to permit pumping at room temperatures.
- Boiling point sufficiently above 300° C. to assure a liquid condition at all times.
- Stability against heat, with enough safety factor to accommodate accidental overheating.
- Controllable vaporization losses.
- Freedom from corrosive action against valves, piping, tank jackets, etc., made of cast iron and steels, bronzes, and stainless steel.
- Freedom from toxicity hazard.

Aroclor, chlorinated biphenyl (registered in U. S. Patent Office), was selected. The pertinent physical characteristics relative to its use as a heat-transfer medium are given in Table I.

FREEDOM FROM FIRE HAZARDS

FLASH POINT. Limitations of this test for the prediction of the fire hazard of relatively nonvolatile organic fluids have been recognized by the American Society for Testing Materials committee (3, 4).

FIRE POINT is a more significant measurement. The Underwriters' Laboratories (10) state that fire tests more truly reflect the (lack of) fire hazard of Aroclor.

SPONTANEOUS IGNITION TEMPERATURE. The combustion-resisting qualities of Aroclor 1248 are indicated by its high spontaneous ignition temperature of 704° C. (1299° F.) determined by Sullivan, Wolfe, and Zisman (9), using the convenient apparatus described by Sormman, Benity, and Heron (8).

Under conditions of industrial use the spontaneous ignition temperature will be determined by factors including the nature of the hot surface, the amount of liquid impinging on it, the volume of enclosed space, and the ventilation.

An accidental failure in a heating system demonstrated the nonflammability of Aroclor 1248 and its freedom from the hazard of fire propagation. An operator's failure to start the circulation of the heat-transfer medium when the gas heater was on resulted in excessive coil temperatures and caused the lower coil to soften and sag into the fire chamber. A weld ruptured and Aroclor 1248 poured into the red-hot fire chamber in contact with the flame. Dense smoke arose from the heater but there was no external fire. After the gas flame was cut off, the smoking stopped.

¹ Present address, Monsanto Chemical Company, Organic Chemicals Division, St. Louis, Mo.

² Present address, Monsanto Chemical Company, Phosphate Division, St. Louis, Mo.

SPRAY FLAMMABILITY. When a tube ruptures in a liquid heat-transfer system under high pressure, a spray or mist forms. The possible fire hazard under these conditions requires considerations not covered by the foregoing discussions relative to the material in the liquid form. In their comprehensive study of flammability of the higher boiling liquids and their mists, Sullivan, Wolfe, and Zisman (9) determined the spray flammability limit of numerous materials in accordance with the percentage of oxygen required for combustion. This value was then correlated with the results of incendiary firing tests of the fluids conducted at the Naval Proving Ground, Dahlgren, Va. The oxygen requirement for Aroclor 1248 combustion in the spray flammability limit studies was found to be 64%. Fluids requiring over 45 to 50% oxygen in the spray test failed to cause a fire in the incendiary test. These results establish the nonflammable and noncombustible qualities of Aroclor 1248.

VISCOSITY CONSIDERATIONS

COLD FLOW. For most inside installations centrifugal pumps will handle Aroclor at reduced rates without preheating. Experience confirms this. Outside installations have been started at 0° C. by heating the pump and feed line until circulation through

TABLE I. PHYSICAL PROPERTIES OF AROCLOR 1248

Appearance	Practically colorless mobile liquid ° C. (° F.)	
Absolute density, g./ml.	1.44 1.41 1.37 1.27 1.17	30 (86) 50 (122) 100 (212) 200 (392) 300 (572)
Absolute viscosity, centipoises	112 17.5 4.2 0.99 0.47	30 (86) 50 (122) 100 (212) 200 (392) 300 (572)
Thermal conductivity, B.t.u./hour/sq. foot/ ° F./foot	0.0613 0.0698 0.0800	30 (86) 50 (122) 100 (212)
Distillation range, A.S.T.M. D-20, ° C.	310-375	
Flash point, Cleveland open cup, A.S.T.M. D 92-40, ° C.	193-199	
Fire point, Cleveland open cup, A.S.T.M. D 93-40	None	
Pour point, A.S.T.M. D-7, ° C.	-7	
Coefficient of expansion, ml./ml./° C. (32- 65° C.)	0.000702	
Specific volume, ml./g.	0.694 0.709 0.728 0.787 0.850	30 (86) 50 (122) 100 (212) 200 (392) 300 (572)
Specific heat, cal./g./° C.	0.363 0.397 0.426 0.454	30 (86) 50 (122) 100 (212) 200 (392)
Vapor pressure, mm. Hg	0.0037 0.16 1.9 18.0 200.0	37.8 (100) 100 (212) 150 (302) 300 (572) 572 (1062)

REY 001425

TABLE II. STABILITY OF AROCLOR 1248 HEATED FOR 30 HOURS

Temperature, C.	Mg. of HCl per Gram of Aroclor
280	0.079
300	0.185
310	0.199
320	0.223
330	0.248

TABLE III. STABILITY OF AROCLOR 1248 CONTINUOUSLY HEATED AT 280° AND 330° C.

Hours	Mg. of HCl per Gram of Aroclor	
	280° C.	330° C.
30	0.079	0.248
60	0.116	0.810
90	0.169	0.933
120	0.194	1.161
150	0.261	1.593

TABLE IV. GAS ANALYSIS OF AROCLOR 1248 HEATED 4 HOURS AT 260° C. AND 210 POUNDS PER SQUARE INCH PRESSURE

Gas	%
Carbon dioxide	None
Carbon monoxide	None
Oxygen (derived from air)	20.2
Methane	0.3
Hydrogen chloride	None
Chlorine	None
Acidity (% by weight HCl)	
Prior to exposure	0.0075
After exposure	0.0075

the heater had been effected so that the system could operate normally.

BOILING POINT

Operating experience has shown that the boiling point of Aroclor 1248 (340° C. at 760 mm.) is enough above the 300° C. operating limit to prevent trouble from this cause. At the maximum operating temperature the vapor pressure is less than 0.5 atmosphere.

HEAT STABILITY

In order to establish a maximum practical operating temperature, the stability of the material when heated to elevated temperatures in the presence of iron was noted. A slow stream of nitrogen was passed over the hot Aroclor to sweep the decomposition products into a caustic trap. The amount of acidic material was determined and calculated as hydrochloric acid. The results given in Table II indicate the stability of Aroclor 1248 when individual samples were heated for 30 hours at the given temperatures. The decomposition is very low at temperatures up to 300° C.

The stability of Aroclor 1248 in contact with iron continuously heated at 280° and 330° C. is indicated by Table III. These test results indicate that Aroclor 1248 in contact with iron can be used satisfactorily at temperatures up to 300° C.

The National Board of Fire Underwriters (10) reported that "decomposition of the product (Aroclor 1248) was not appreciable at temperatures below 400° C., but became increasingly apparent at higher temperatures."

Their workers analysed the decomposition products of Aroclor 1248 heated in the presence of hot iron at 459° C. and also heated in an iron cylinder

at 340° C. fitted with an internal gas burner so that the gas flame impinged directly on the surface of the Aroclor. Analysis of the gases produced under these conditions indicated 0.6% carbon monoxide, 0.17% oxygen (derived from the air), 0.99% hydrogen chloride, 2.1% combustible gas calculated as methane, 0.002% chlorine, and no phosgene.

The same workers studied the stability of Aroclor when heated for 4 hours in an iron pipe at 260° C. under an internal pressure of 210 pounds per square inch, resulting from the introduction of compressed air. Following this treatment and cooling, the gases removed from the system were analysed. The acidity of the Aroclor was determined prior to and after exposure to these conditions.

The results given in Table IV reflect an extremely small amount of decomposition under conditions similar to those selected for the practical use of Aroclor 1248 as a heat-transfer medium.

In actual practice using the type of heating unit described below there has been no evidence of hydrochloric acid effect and no carbon deposits have been noted in the heater, pipes, or valves. The heaters have been operated successfully with combustion gases at approximately 600° C. in contact with the coils.

At one time, a spiral coil type of heater was built and through faulty design a burner tunnel was located 1.5 inches from the 2-inch steel pipe coil. The radiation from the white-hot refractory tunnel and the direct impingement of the flame on the pipe caused the pipe to glow a dark red for a space of about 2 inches. This unit was operated almost 3 months before a circulation stoppage occurred. When the line was opened lumps of carbon were found to have come loose and moved forward to lodge in the globe valves. The lumps measured about 1 X 2.5 cm. and one face was formed to fit the pipe curvature. No hydrochloric acid effect was noted and the system was put back into operation after the burner location was changed.

CONTROLLABLE VAPORIZATION LOSSES

The heating systems in which Aroclor 1248 is used are sealed except for the expansion tank, which has a loose cover or a vent pipe. Because this tank is separated from the stream by a substantial length of pipe, the temperature in the tank remains low.

In the light of the relatively low vapor pressure of Aroclor 1248 (7), and as it is unlikely that the expansion tank will ever reach even the 1-mm. state (130° C.), there should not be a measurable loss of Aroclor from the system. Actual experience bears out this contention.

OTHER LOSSES. Although Aroclor darkens on use, its characteristics remain the same and replacement has not been found necessary after 7 years of continuous use. Accidental leaks or spills constitute the only observed losses.

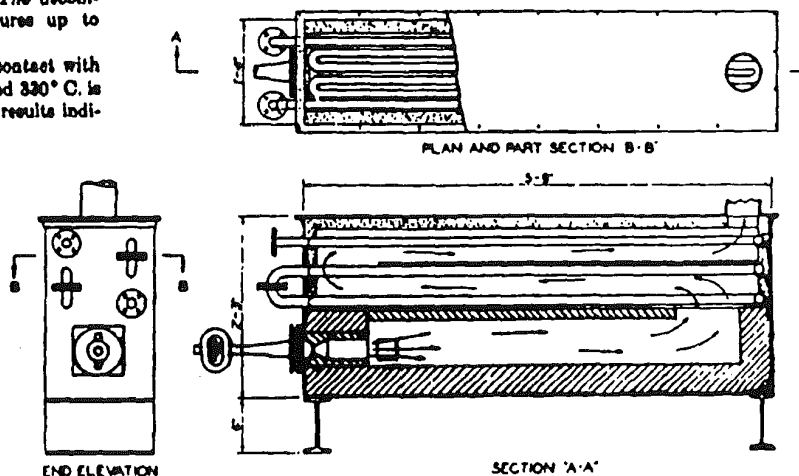


Figure 1. Heater

REV 001426

TABLE V. RESISTANCE OF STRUCTURAL MATERIALS TO AROCLOR 1248

Metals	At 25° C.	At 125° C.	Metals	At 25° C.	At 125° C.
Aluminum	R	R	Zinc	R	R
Copper	R	D	Mild steel	RR	R
Magnesium	RR	M	Phosphor bronze	RR	D
Nickel	RR	M	Red brass	D	D
Silver	R	R	Stainless steel	RR	RR
Tin	RR	R	Yellow brass	R	Re

RR. Excellent resistance, less than 1.0×10^{-4} cm. per day penetration or 0.0014 inch per year.

R. Good resistance, penetration between 1.0×10^{-4} and 10×10^{-4} cm. per day or between 0.0014 and 0.014 inch per year.

D. Doubtful resistance, penetration between 10×10^{-4} cm. per day and 100×10^{-4} cm. per day or between 0.014 and 0.14 inch per year.

M. Following letter indicating resistance, significant material may be better than indicated if totally immersed, as weight loss is believed to come from oxidation of part of test strip exposed to air.

FREEDOM FROM CORROSIVE ACTION

The resistance of various metals (7) at 25° and 125° C. is given in Table V.

Similar studies made at 325° C. (8) indicate that the penetration, in inches per year, for mild steel is 0.0028; for yellow brass, 0.00047; for copper, 0.00145.

Many years of practical operating experience with Aroclor 1248 as a heat-transfer medium have shown that the material is practically noncorrosive to valves, piping, tank jackets, etc., made of cast iron and steel, bronze, and stainless steel.

FREEDOM FROM TOXICITY HAZARD

Aroclor 1248 is a very stable, unreactive liquid. If the material is spilled on the skin, there are no noticeable ill effects; however, it is well to wash the skin with soap and water after contact.

A skin burn resulting from accidental contact with hot Aroclor should be treated in the normal procedure used for hot oil burns. Aroclor adhering to the burned area need not be removed immediately unless treatment of the burn demands it; in this case soap and water or repeated washings with a vegetable oil (linseed oil) should be used.

The vapors emitted by Aroclor 1248 heated to elevated temperatures are injurious to the liver on prolonged exposure and should not be breathed. Drinker (5) indicated that 0.5 mg. of Aroclor 1248 per cubic meter of air is the maximum safe amount permissible in workrooms.

In commercial heat-transfer installations, the presumption is that the Aroclor is in a closed system free from leaks. Accordingly, there should be no opportunity for workers to come in contact with vapors from the hot heat-transfer medium.

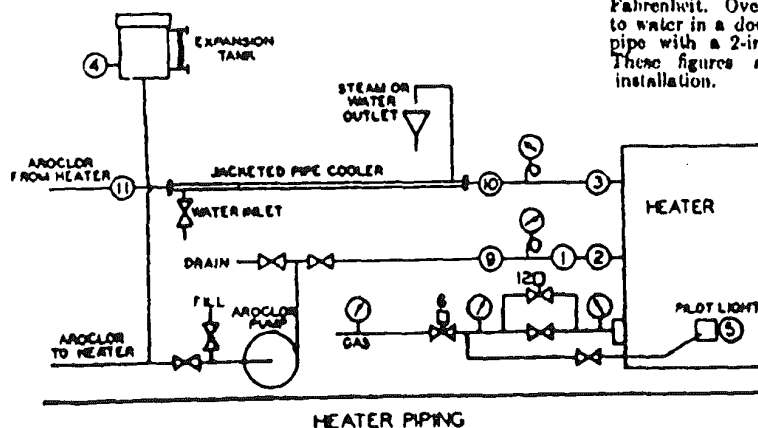


Figure 2. Cooler, Pump, and Expansion Tank

DESIGN AND CONSTRUCTION

HEATING SYSTEM. The heating system required to utilize Aroclor 1248 as the exchange medium includes a heater (Figure 1), cooler, pump, and expansion tank (Figure 2), and control and safety circuits (Figure 3).

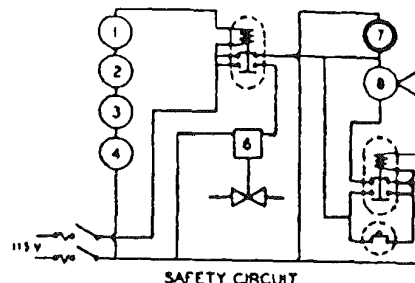


Figure 3. Control and Safety Circuit

HEATER DESIGN. The general requirements of the heater are compactness, ease of construction and service, and avoidance of direct flame impingement on the tubes.

Direct flame impingement is prevented by directing the gas flame through an enclosed channel with half-thickness fire brick protecting the tubes above until the high temperature of the flame is reduced by heat conducted through these bricks and radiated to the two bottom coils. The size of the heater is reduced to a minimum by using only 4.5 inches of insulating fire brick in the hottest areas and 2 inches of Eagle No. 66 insulation on the cooler spots.

Two sizes of units are used: One has a maximum capacity of 200,000 B.t.u. per hour, as shown in Figure 1. The larger has a range of 200,000 to 400,000 B.t.u.

The small size consists of 90 feet of 1-inch standard weight steel pipe made into three coils of six pipes each and connected in series. The larger size consists of 144 feet of 1.5-inch standard weight steel pipe arranged in the same fashion. Results of tests on the small-size heater covering temperatures from 150° to 300° C. show temperature rises to 10° to 20° C. in the Aroclor while circulating at a rate of 15 to 20 gallons per minute. The outlet gas temperature is consistently within 75° C. of the outlet Aroclor temperature. It is observed that the bottom two coils absorb the major part of the heat. The small unit indicates 50 to 60% efficiencies for capacities up to 200,000 B.t.u. per hour when a natural gas of 1000 B.t.u. per cubic foot is burned. A Surface Combustion Company high pressure inspirator and tunnel burner set is used in this installation.

Over-all heat-exchange coefficients (C) for the furnace are in the range of 7 to 10 B.t.u. per hour per square foot per degree Fahrenheit. Over-all heat-exchange coefficients for Aroclor 1248 to water in a double pipe heat-exchanger made from 1.25-inch pipe with a 2-inch pipe jacket are in the 120 to 180 range. These figures are calculated from test results on this installation.

COOLER. A very useful adjunct to the system is a double pipe cooler on the outlet of the heater shown in Figure 2. By turning water into the jacket, the Aroclor can be cooled and the temperature of the system lowered. This is helpful when it is necessary to cool a batch before removing it or when an exothermic reaction starts to get out of control.

PUMP. The pump for circulating the Aroclor 1248 may be any one of a number of standard centrifugal units designed for hot liquid service.

REV 001427

01131-A DIRECT #2
01/12/72

ORGANIC DIVISION SPECIALTY PRODUCTS
PRODUCT/CUSTOMER SALES REPORT

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PAGE 68

		- IN THOUSANDS OF POUNDS AND DOLLARS -																	
MS C	MS REP	NAME OF PRODUCT/CUSTOMER	POTENTIAL	LAST YEAR SALES	SALES CUM FOR CURR YEAR	SALES CUM TID	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CUST ID / MAJOR CUS ID
		110. WABINDL FR-B																00300A	1060-265-10

1252	REYNOLDS METALS MESSENA NY				12.0		12.0												10067790
------	----------------------------	--	--	--	------	--	------	--	--	--	--	--	--	--	--	--	--	--	----------

REV 000031

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31131-A DIRECT 02
01/12/72

ORGANIC DIVISION SPECIALTY PRODUCTS
PRODUCT/CUSTOMER SALES REPORT

FOR DEC 1971

PAGE 78

- IN THOUSANDS OF POUNDS AND DOLLARS -																			
NO.	REV.	NAME OF PRODUCT/CUSTOMER	POTENTIAL	PAST YEAR SALES	FOREIGN CUM YTD	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CUST ID / MAJOR CND GP	
		ETHANOL FR-2															00357A		104Q-265-1

144	ALUMINUM METALS MESSENA NY	6.00	12.0	12.0															10067790
-----	----------------------------	------	------	------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----------

KEY 000032

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81131-A DIRECT 02
01/12/72

ORGANIC DIVISION SPECIALTY PRODUCTS
PRODUCT/CUSTOMER SALES REPORT

FUN DEC 1971

PAGE 256

		- IN THOUSANDS OF POUNDS AND DOLLARS -																	
M C N	MS REF	NAME OF PRODUCT/CUSTOMER	FORMULA	LAST	FOR CUM	SUM	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPI	OCT	NOV	DEC	CUM D / MAINT CUM CP
				YEAR	YEAR	CUM													
		TRANSFORM PYRAMOL A13030																0035HA	1050-300-14

1237	REYNOLDS METALS MESSENA NY	3.30	4.73				4.73												10047790
------	----------------------------	------	------	--	--	--	------	--	--	--	--	--	--	--	--	--	--	--	----------

REV 000033

01131-A DIRECT #2
01/12/72

ORGANIC DIVISION SPECIALTY PRODUCTS
PRODUCT/CUSTOMER SALES REPORT

FOR DEC 1971

PAGE 134

- IN THOUSANDS OF DOLLARS AND CENTS -

NO C	SLS REP	NAME OF PRODUCT/CUSTOMER	POTENTIAL	LOS YEAR SALES	LOS FOR CURR YEAR	SLS CURR YTD	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CUST ID / MATERIAL CND LP
		HYDRAUL 135															00502A		4592-135-11

REV 000034

1273	KEYNOLD METALS MESSENA NY	70.0	23.7	50.0	13.5	5.30	5.30							2.69					10067790

REPORT B1476-A

01/09/73

MICC DIV-02 SPECIALTY PRODUCTS
NO.4 CUSTOMER/PRODUCT SALES REPORT FOR DEC 1972
-IN ACTUAL POUNDS AND DOLLARS-

PAGE 390

TOTAL MONTH SALES		Y-T-D SALES		TOTAL LAST YEAR SALES		TOTAL YEAR	CUST-10
POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS	DOLLARS	GOAL LBS	NAME-GRD-CP
REYNOLDS METALS MESSENA NY						AR 617446	10067790
1237 TRANSFORM PYRAMID A13000				4.725	1.063		1050-300-16

REY 000035

REPORT H1476-A

1/25/73

PICC DIV-02 SPECIALTY PRODUCTS
NO.4 CUSTOMER/PRODUCT SALES REPORT FOR DEC 1972
-IN ACTUAL POUNDS AND DOLLARS-

PAGE 1

TOTAL MONTH SALES	Y-T-D	SALES	TOTAL LAST YEAR SALES	TOTAL YEAR	COST TO
POUNDS	DOLLARS	POUNDS	DOLLARS	GOAL LBS	PAJR-CND-CP

REYNOLDS METALS MESSENA NY
1273 DISC PCB PCT

1273 THEMINUM FR-1

25.450

7.551

AR 617466

1006719
9998-000-11

12.000

3.960

1040-245-11

REY 000036

NEW YORK

- 15 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
	3.0	3.0
27.0	21.6	48.6
0.2	0.1	0.3
0.1		0.1
39.6	9.0	48.6
<u>3.0</u>	<u>26.4</u>	<u>29.4</u>
42.6	35.4	78.0
	0.5	0.5
0.1		0.1
1.9	4.5	6.4
	0.6	0.6
	0.1	0.1

REV 000276

NEW YORK

- 16 -

<u>1968</u>	<u>1969</u>	<u>Total</u>
0.6	0.6	1.2
	0.8	0.8
0.2		0.2
0.3		0.3
3.6	1.8	5.4
0.1	0.2	0.3
0.2		0.2
0.6		0.6
	0.1	0.1
	0.1	0.1

REY 000277

NEW YORK

- 17 -

<u>1958</u>	<u>1969</u>	<u>Total</u>
0.2	0.2	0.4
	0.6	0.6
0.2		0.2
14.0	4.2	18.2
0.2		0.2
10.0		10.0
<u>24.4</u>	<u>0.6</u>	<u>0.6</u>
	4.8	29.2
	3.6	3.6
0.6		0.6
0.5		0.5
	0.5	0.5
<u>103.0</u>	<u>126.0</u>	<u>229.0</u>
<u>TOTAL</u>	1492.1	3041.6

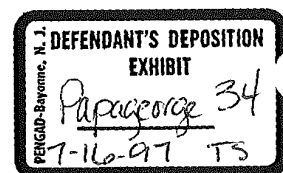
REV 000278

EXHIBIT L

(REVISED)

REY 000279

REDACTED



WATER_PCB-SD0000064321

PCB WASTE RETURNS

1971

Vendor

Pounds

8,775

2,208

3,400

3,000

622

2,739

1,800

1,870

83,300

5,505

9,570

11,400

2,700

460

84,000

REY 000280

-Continued-

PCB WASTE RETURNS

<u>Vendor</u>	<u>1971</u>	<u>Pounds</u>
		2,040
		11,826
		718
		17,500
		4,050
		1,110
		39,683
		1,646
		99,462
		1,200
		1,650
		9,264
		5,020
		1,200

REY 000281

-Continued-

PCB WASTE RETURNS

Vendor

1971

Pounds

7,425
14,143
5,135
2,016
333
3,354
1,916
51,500
520
6,500
1,794

1,605
6,086
6,180

5,370

1,924

29,988

7,200

1,800

1,840

1,185

REY 000282

-Continued-
PCB WASTE RETURNS

<u>Vendor</u>	<u>1971</u>	<u>Pounds</u>
		1,106
		750
		1,912
		586
		14 000
		10,747
		2,352
		3,250
		3,000
		1,200
		2,710
		600
		3,410
		1,200
		5,101
Reynolds Metal		7,655
(Massena, N.Y.)		3,370
(Longview, Wash.)		

REY 000283

-Continued-
PCB WASTE RETURNS

<u>Vendor</u>	<u>1971</u>	<u>Pounds</u>
		66,547
		5,392
		90,000
		1,125
		3,900
		786
		4,782
		2,750
		57,880
		1,790
		135,167
		16,600
		18,822
		75,800
		7,425
		16,484

REY 000284

-Continued-

PCB WASTE RETURNS

<u>Vendor</u>	<u>1971</u>	<u>Pounds</u>
		914
		5,000
Monsanto Company J.F. Queeny Plant		<u>93,300</u>
1971 Total		1,242,945

REY 000285

ITEM 5 -- ATTACHMENT B

PCB RETURNS

1971

Vendor

Pounds

8,775

2,208

3,400

3,000

622

2,739

1,800

1,870

83,300

5,505

9,570

11,400

2,700

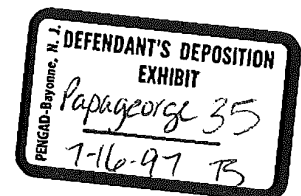
460

84,000

OK 11/18
~~1,149,641~~
1,149,641
no pic

REY 000286

REDACTED



WATER_PCB-SD0000064328

ITEM 5 -- ATTACHMENT B

-Continued-

1971 PCB RETURNS

Vendor

Pounds

2,040

11,826

718

17,500

4,050

1,110

39,683

1,646

99,462

1,200

1,650

9,264

5,020

1,200

REY 000287

ITEM 5 -- ATTACHMENT B

-Continued-

1971 PCB RETURNS

Vendor

Pounds

7,423
14,143
5,135
2,016
333
3,354
1,916
51,500
520
6,500
1,794

1,605

6,086

6,180

5,370

1,924

29,988

7,200

1,800

1,840

1,185

REY 000288

ITEM 5 -- ATTACHMENT B

-Continued-

1971 PCB RETURNSVendorPounds

1,106

750

1,912

586

14 000

10,747

2,352

3,250

3,000

1,200

2,710

600

3,410

1,200

5,101

Reynolds Metal
(Massena, N.Y.)
(Longview, Wash.)

7,655

3,370

REV 000289

ITEM 5 -- ATTACHMENT B

-Continued-

1971 PCB RETURNS

Vendor

Pounds

66,547

5,392

90,000

1,125

3,900

786

4,782

2,750

57,880

1,790

135,167

16,600

18,822

75,800

7,425

16,484

REY 000290

TABLE VI. PIPING DETAIL

(Dimensions in inches)		
Pipe	1/4 through 1/2	Schedule 80, A.S.T.M. A53 or A106
Construction	1 through 6 1/4 through 1/2 1 through 6	Schedule 40, A.S.T.M. A53 or A106 Screwed Flanged Bend in shop and field where possible. Must be cleaned to remove scale
Elbs, tees, and reducers	1/4 through 1/2	Forged steel screwed, Crane 300d series
Flanges	1 through 6	Welded flanges, Crane 300e Series 30 (to match valves)
Rolls	1 through 6	Aluminum alloy A.S.A. B-18.2 with hex- agonal nuts for service below 500° F. Above use alloy steel, Crane tri- plex A.S.T.M. A96
Unions	1/4 through 1/2	Crane 252h forged steel Crane 428 high tem- perature thread compound
Dope		Soft iron flag 8at or entrusted
Gaskets		Crane 300d W, screwed, gate
Shut-off valves	1/4 through 1/2 1 through 2 2 1/2 through 6	Crane 361W, flange, gate Crane 33XR, flange, gate Crane 3640 XR, screwed, globe
Control valves	1/4 through 1/2 1 through 2 2 1/2 through 6	Crane 3650 XR, flange, globe Crane 131 XR, flange, globe Crane 3674 X, screwed
Check valves	1/4 through 1/2 1 through 2 2 through 6	Crane 3664 X, flanged Crane 139 X, flanged
Safety valves	1/4	Consolidated 1070 BW, screwed
Relief valves	1 1/2 through 3	Consolidated 1012 W, flanged
Pressure picking		Goniat 340D or Durametallite D- 110
Clamp and glass	1/4 size	Type 100 PCPR Marsh O-100 1/4-in. inch size sphen with Crane 22211 bar stock valve, Jerguson Series K20 Reflex type liquid level gage
Strainers	1/4-1/2 1 through 3	821 Yarrow threaded 822 Yarrow flanged

The Dayton Dowd Type C pump is an example of the type required. It should be made of cast steel and have a water-cooled stuffing box and water-cooled bearings. The stuffing box should have room for at least six rings of packing and a lantern ring. Durametallite No. D-110 or Garlock No. 234 may be used for packing the pump. An open impeller is desirable, as it will handle the cool, more viscous liquid on starting the system better than will a closed impeller. Enough horsepower for the most viscous conditions is required.

PIPING SYSTEM AND EXPANSION TANK. The detail of the piping system for Aroclor 1248 used up to temperatures of 300° C. (572° F.) and 100 pounds per square inch pressure is given in Table VI. The valves and specialties given indicate the type required. All piping larger than 0.75 inch is flanged or welded; experience has shown that hot Aroclor penetrates screwed joints of the larger sizes. Steel and cast steel are used throughout.

The system requires an expansion tank located at the highest level of the installation. The size of this tank is normally about 25% of the capacity of the Aroclor system. Connections with valves, made on either side of the pump, enable the operator to connect a flexible hose and to pump in or out as required.

For operation in locations where the Aroclor temperature may drop to where the attendant viscosities may make pumping impractical in the system as designed, it may be desirable to steam-jacket the Aroclor circulating lines to facilitate rapid start-up. Suitable safety provisions, such as safety pop-off valves, must be installed in the steam jacket system to prevent pressure ruptures which would develop if any condensate remained in a closed system during high temperature operation.

In order to establish operating conditions and to check the operation of the heater itself, it is often desirable to measure the temperatures of the Aroclor in and out of the heater and cooler. Items 9, 10, and 11 (Figure 2) provide for this. They may be dial thermometers or mercury bulb thermometers of any commercially available type recommended for the service.

TABLE VII. SAFETY AND CONTROL EQUIPMENT

1. High pressure alarm (detects stoppage of pipe)	Mercoild DA-31, open circuit on high pressure. Actual settings depend on individual layout
2. Low pressure alarm (detects stoppage of pump)	Mercoild DA-31-3, open circuit on low pressure. Actual settings depend on individual layout
3. Thermostat (detects excessive heating hence obstruction of flow)	Fanwal 18002. Contacts open on temperature increase
4. Flow switch (detects leakage from system)	Mercoild Figure 40. S.P. switch. Open at low level
5. Flame failure system (cuts off gas if pilot flame goes out)	Combustion Control Corp. Fireye FFB. Flame failure control for manual ignition gas burner systems
6. Gas valve (cuts off in case preceding devices act)	General Control Corp. K-10-2. Closes with current off
7. Red light (alarm)	Killark VA-1 60 W. or Benjamin 7013-V
8. Horn (sounds alarm)	Edwards 312
Alarm relay	Type C-1104 1-NO, 1-NC watertight (1)
Stop horn button	Type C-1104 1-NO, 1-NC, watertight (1)
9. Thermometer well (visual check of heater performance)	1-HA-4 (2) 0-300° C. mercury bulb thermometer
10. Thermometer well (visual check of heater performance)	0-300° C. mercury bulb thermometer
11. Thermometer well (visual check of cooler performance)	0-360° C. mercury bulb thermometer
12. Solenoid valve	General Control K-10-2. Controls Aroclor temperature to meet demands of system

For automatic temperature control a solenoid valve, item 12, is indicated in a by-pass arrangement with a manually operated needle valve. The needle valve is adjusted to give almost enough heat to meet the requirements and the actual control is carried on by the solenoid valve, which opens and closes as directed by a temperature-control instrument connected to the equipment being heated.

One unit was set up with temperature control using a Leeds & Northrop Model S all-electric control with droop corrector. Very close control over a wide range of heat demand resulted, when a throttling range adjustment of 4 was used on this control device.

SAFETY CIRCUIT. Figure 3 shows a safety circuit which automatically protects the system by closing off the gas supply in the event of faulty operating conditions. Provision is made for shutting off the warning horn while the system is being put back into operation after a safety shutdown.

A detailed list of the safety and control equipment is given in Table VII. The equipment named indicates the type required.

ACKNOWLEDGMENTS

The authors are grateful to A. M. Ellenburg of Monsanto's Research Laboratory at Anniston, Ala., for furnishing many of the technical data about Aroclor 1248 and for assistance in preparing the manuscript.

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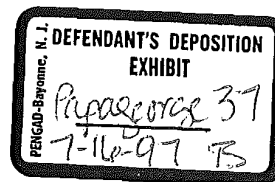
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Part 34.34 resins and plasticizers for chlorinated rubber

TECHNICAL BULLETIN NO. 11-34

1957, 1958



ST. LOUIS, MO. 63101

MONS 078201

Some Important applications for protective and decorative coatings plasticized with AROCLOR compounds —

Wood and metal used in yachts, barges and other marine craft.

Structural steel for bridges, buildings, roofs and power-lines.

Structural materials at chemical plants, pulp and paper mills textile mills, petroleum refineries and gas works for protection against acid fumes, alkalies and gas.

Tank cars and other rolling stock and construction machinery for protecting against corrosive materials and weathering.

Equipment and stop-off lacquers used in electroplating.

Masonry floors and walls. Concrete swimming pools. Highway markings.

Cable coatings requiring fire resistance, chemical resistance, and excellent electrical properties.

Textile coatings resistant to chemicals, fire and water.

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MCNS 078203

AROCLOR®

resins and plasticizers for chlorinated rubber

INTRODUCTION

Monsanto produces a series of chlorinated biphenyls and polyphenyls identified by the trademark *Aroclor** for use as plasticizers and resins for chlorinated rubber base lacquers, varnishes and paints. These protective coatings are fire resistant, corrosion resistant, chemical resistant (to acids, alkalis and water), and have good electrical insulating properties.

When properly pigmented, these coatings have unusually good weatherability. Chlorinated rubber films plasticized with an *Aroclor* grip common structural materials in strong adhesive bonds and the addition of an *Aroclor* improves the flexibility and life of chlorinated rubber and plastic coatings.

The formulations suggested in this bulletin are common in commercial practice today. They are given as a starting point or guide in developing formulations that expand the outstanding qualities of these compounds.

Naming of Aroclor Compounds

The last two digits in a numbered series refer to the degree of chlorination by weight. *Aroclor* 1248 is a biphenyl with 48 per cent chlorination. *Aroclor* 5460 is a terphenyl with 60 per cent chlorination. Two special mixtures are:

Aroclor 4465—a 60:40 mixture (biphenyl to terphenyl) with 65 per cent chlorination.

Aroclor 2565—a 75:25 mixture (biphenyl to terphenyl) with 65 per cent chlorination.

The physical properties of the *Aroclor* plasticizers vary gradually with the degree of chlorination. At low percentages of chlorine, such as *Aroclor* 1221 and 1232, the compounds are clear and very fluid. At 42 per cent they resemble vegetable oil; at 48 per cent they thicken slightly and look more like a medium-grade mineral oil. At 54 per cent chlorine, the compounds are quite viscous; if a bottle containing them is turned upside down, the bubble rises slowly to the top. At higher percentages, the biphenyls become gumlike, and a fingerprint on the surface lasts several days. Then at 68 per cent chlorine, the range is complete; *Aroclor* 1268 is a white powder. The terphenyls (*Aroclor* 5442 and 5460) are both yellowish solids.

The gradual change in physical properties often allows a processor to select a plasticizer particularly suited for his operation. For example, if he wants to dry mix the plasticizer, *Aroclor* 1268 could be used. It melts at higher processing temperature and can act as a solvent-plasticizer.

**Aroclor*: Monsanto Trademark, Reg. U.S. Pat. Off.

MONS 078204

Properties of Chlorinated Rubber

"Parlon" is a mixture of two polymers with an average chlorine content of 67 per cent made by chlorinating natural rubber. The typical properties of "Parlon" as given by the manufacturer, Hercules Powder Company, Wilmington, Delaware, are listed in Table I.

Table I. Typical Properties of "Parlon"

General

Form as shipped.....	White, granular powder
Color of film.....	Water white
Odor.....	None
Clarity of film.....	Good
Taste.....	None
Moisture, per cent as shipped.....	0.5 maximum

Physical

Specific gravity.....	1.64
Specific volume, as shipped, in cubic inches per pound.....	16.9
Bulking value, gallons per pound.....	0.0735
Index of refraction.....	1.554

Chemical resistance to:

Acids, weak.....	excellent
Acids, strong.....	excellent
Alkalies, weak.....	excellent
Alkalies, strong.....	excellent
Salt spray.....	good
Alcohols.....	excellent
Ketones.....	soluble
Esters.....	soluble
Hydrocarbons, aromatic.....	soluble
Hydrocarbons, aliphatic.....	good
Oils, mineral.....	good
Oils, animal.....	poor
Oils, vegetable.....	poor

Electrical (clear unplasticized film*)

Specific surface resistance, ohms $\times 10^6$	2,000
Dielectric strength, volts per mil (ASTM method).....	2,300
Dielectric constant at 25°C. and 1,000 cycles.....	3.1
Power factor at 25°C. and 1,000 cycles.....	0.0015 to 0.0030
Power factor at 25°C. and 1,000 cycles, after immersion in water for 140 hours and surface wiped dry.....	0.0027

*Films used in tests were laid down from a toluene solution.

Properties, cont'd.

Mechanical (clear unplasticized film*)	20-cp. type	1,000-cp. type
Tensile strength, pounds per square inch, dry.....	4,270	4,850
Tensile strength, pounds per square inch, wet.....	4,100	4,360
Elongation, per cent, dry.....	3.6	3.3
Elongation, per cent, wet.....	3.8	3.4
Modulus of elasticity, pounds per square inch.....	1.4×10^5	—
Hardness, Sward index, per cent of glass.....	90	—

Note: Flexibility of "Parlon" film increases with viscosity of "Parlon" used.

Thermal (clear unplasticized film*)

Burning rate.....	nonflammable
Effect of dry heat on film.....	stable up to and at 125°C.
Softening point.....	decomposes at 135° to 150°C.

Physical-Chemical (clear unplasticized film*)

Effect of sunlight.....	Discolors and embrittles
Effect of aging.....	Very slight
Effect of hot water.....	Blushes
Effect of cold water.....	None
Moisture absorption (80% relative humidity for 24 hours), per cent.....	0.27
Moisture vapor permeability of 0.003-inch film (grams water/ square centimeter/0.01 centimeter/hour at 21°C.).....	0.2×10^{-4}

Viscosity Types

Table II. "Parlon" Viscosity Types

Viscosity Type	Viscosity Range (centipoises)
5 cp.	5 to 7
10 cp.	8 to 12
20 cp.	16 to 25
125 cp.	110 to 190
1,000 cp.	800 to 2,000

Examples of actual or suggested applications of the several viscosity types are given below:

Type	Example of Use
5 cp.	In printing inks and as a fortifier for alkyd resin enamels.
10 cp.	In high-solids finishes and as a fortifier for alkyd resin and oleoresinous varnishes and enamels.
20 cp.	As a film-former in protective coatings and as a fortifier in enamels and varnishes.
125 cp.	As a film-former in protective coatings, in paper lacquers, adhesives, and textile finishes.
1,000 cp.	As a film-former in adhesives, textile finishes and other finishes where flexibility is important.

*Films used in tests were laid down from a toluene solution.

Solvent Compatibility

Solvents and solvent mixtures suggested for use in preparing formulations with *Aroclor* and "Parlon" are given in Table III:

Table III. Suggested Solvents for Compositions with *Aroclor* and "Parlon"

"Amsco Solv," B and E	Methyl ethyl ketone
Amyl acetate	Methyl isobutyl ketone
Butyl acetate	Methyl salicylate
Carbon tetrachloride	Notol
"Cellosolve"	Octyl acetate
Diacetone alcohol	"Sovasol" Nos. 74, 75
Diethyl carbonate	"Solvesso 100"
Ethyl acetate	"Tollac"
Ethylene dichloride	Toluene
Hi-Flash naphtha	"Union Aromatic Solvent" 3553-10
Methyl acetate	"Union Solvent No. 30"
Xylene	

Formulations and Properties of Chlorinated Rubber

Chlorinated Rubber Films

Aroclor 1262 and 5460, resinous types, show good compatibility in chlorinated rubber films laid down from toluene solution containing 20 per cent of the plastic in ratios of 2:1 and 1:1 ("Parlon" to *Aroclor*). The plasticizer types, *Aroclor* 1242, 1254 and 1260, also show good compatibility. Formulations and properties of films derived from both resin- and plasticizer-type *Aroclor* are listed below.

Table IV. Formulations for *Aroclor* Resin

Ingredient	Parts by Weight					
"Parlon," 20-cp.	16	16	12	12	12	
<i>Aroclor</i> 5460.....	8	8	8	12	12	12
Dibutyl phthalate.....	—	4	—	—	3	—
Tung oil, Thermolyzed, 976.....	—	—	5	—	—	3.75
Xylene or butyl acetate.....	76	72	71	76	73	72.25

Table V. Formulations for *Aroclor* Plasticizer

Ingredient	Parts by Weight	
"Parlon," 20-cp.	20	20
<i>Aroclor</i> 1254 or 1260.....	4	20
Xylene.....	76	70

Films cast from these lacquers show improved characteristics due to *Aroclor*. Some of their advantages are listed below:

Adhesion

Unplasticized chlorinated rubber films have very poor adhesion. The lacquer film containing *Aroclor* 5460 gave good adhesion to aluminum, bare steel, primed steel, galvanized iron and "Transite" surfaces. Other commercial resins, particularly oil-modified alkyd resins, gave better adhesion to glass, tin, copper, sealed wood and cellophane.

The lacquer films plasticized with *Aroclor* 1254 or 1260 gave good adhesion to "Transite," cellophane, galvanized iron and primed steel surfaces. Some of the other commercial plasticizers tested in similar films gave better adhesion to aluminum, tin, bare steel, copper and sealed wood surfaces.

Though compounds with an *Aroclor* alone possess pronounced adhesive qualities, better adhesion to all of the surfaces results if mixtures of *Aroclor* or varied contents are used.

Resistance to Aqueous Solutions

Chlorinated rubber films with *Aroclor* 1254 or 1260 (plasticizers) and *Aroclor* 5460 (resin) show satisfactory resistance to solutions of 10 per cent hydrochloric acid, 5 per cent sodium hydroxide, 5 per cent sodium chloride and water spot tests.

Film Hardness

Softer films were produced with *Aroclor* 5460 in ratios of 5:10 and 10:10 (*Aroclor*: "Parlon") than with other commercial resins in similar mixtures. Likewise, softer films result from *Aroclor* 1254 or 1260 in ratios of 2:10 and 5:10 (*Aroclor*: "Parlon") than with other commercial plasticizers at these concentrations. From these tests compounds with *Aroclor* are shown to have strong plasticizing action on chlorinated rubber.

Cold-Check Resistance

Aroclor 5460 is superior to phenol formaldehyde resins in cold-check resistance imparted to chlorinated rubber films, but not as good as alkyds modified with long oil. *Aroclor* 1260 used as a plasticizer proved somewhat better than *Aroclor* 1254.

Weather Resistance

Pigmented chlorinated rubber finishes containing *Aroclor* have consistently withstood outdoor weather tests, but unpigmented finishes do not stand up well regardless of the resin or plasticizer used.

Poor resistance to ultraviolet light is also a weakness of chlorinated rubber. Most pigments (except ultramarine blue) are usable with "Parlon" and are recommended if the coating is to be subjected to outdoor weather or ultraviolet light. However, pigment protection varies considerably. Inspection of alkyd enamels fortified with "Parlon" showed weatherability varied from 63 months with chrome green to 4 months for titanium dioxide—iron blue combinations.

Sanding and Polishing Properties

Plastic films compounded with "Parlon" and containing *Aroclor* 5460, 1254 and 1260 have shown satisfactory sanding and polishing characteristics.

Applications

Alkaline-Resistant Coatings

Products containing *Aroclor* and chlorinated rubber are highly resistant to alkalis and moisture. Paints with combinations of *Aroclor* and chlorinated rubber are used in large quantities for concrete floors, walls, swimming pools and other surfaces. A paint formulation is given in Table VI.

Table VI. Paint Formulation for Alkaline Surface
(Parts by Weight)

Ingredient	Formulation		
	Formula 1 (basement floor)	Formula 2 (Fed. Spec. TT-P-91)	Formula 3 (swimming pools)
"Parlon," 20-cp. type.....	18	18	14.6
<i>Aroclor</i> 1254.....	10	10	4.4
"Rezyl 869".....	8	—	—
<i>Aroclor</i> 5460 or "Cumar P10".....	—	6	—
"Beckosol 31".....	—	—	2.9
Tung oil, Thermolyzed, 976.....	—	—	4.4
Titanium dioxide.....	16	16	19.7
Zinc oxide.....	2	2	6.5
Silica flour.....	3	—	—
Carbon black.....	0.2	0.5	—
Xylene.....	42.8	47.5	—
Hi-Flash naphtha.....	—	—	47.5
Totals.....	100	100	100

Chemical-Resistant Finishes

Particular care is necessary in choosing resins and plasticizers for chemical-resistant paints. Chlorinated rubber formulations with an *Aroclor* have proved outstanding for acid and alkali resistance. Five formulations are shown in Table VII.

Table VII. Formulations for Chemical-Resistant Paints
(Parts by Weight)

Ingredient	Formulation				
	1 Interior use, acids and alkalies	2 Exterior use, acids	3 Exterior use, alkalies	4 Maximum resistance, acids and alkalies	5 Soap resistant
"Parlon," 20-cp. type.....	16	16	16	18	12
<i>Aroclor</i> 5460.....	6.4	—	—	—	6
"Bakelite XJ-12895".....	—	—	6.4	—	—
"Rezyl 807" (solids).....	—	6.4	—	—	—
<i>Aroclor</i> 1254.....	8	4.8	4.8	8	—
<i>Aroclor</i> 1260.....	—	—	—	6	—
Tung oil, Thermolyzed, 976..	—	4.8	4.8	—	7.7
Iron oxide.....	16	16	16	18	—
Titanium dioxide.....	—	—	—	—	18
Zinc oxide.....	—	—	—	—	6
Xylene.....	53.6	52	52	39	28
Hi-Flash naphtha.....	—	—	—	11	10.3
Toluene.....	—	—	—	—	12
Totals.....	100	100	100	100	100

These formulations were applied to metal bars or panels and tested for resistance.

Formula 1 showed good resistance to 10 per cent hydrochloric acid and 5 per cent sodium hydroxide solutions.

Formula 2 gave excellent outdoor protection to metal surfaces on plants manufacturing acids.

Formula 3 performed well on exteriors of plants producing alkali.

Formula 4 had excellent resistance to acids, alkalis and salt solutions. It also showed good adhesion to glass and other surfaces.

Formula 5 proved good for resistance to warm, soapy water.

Note: No finishes with *Aroclor* or chlorinated rubber are recommended for continuous exposure at temperatures above 140° F.

Marine Finishes

The marine industry makes great use of chlorinated rubber coatings plasticized with *Aroclor* to protect wood and metal on boats, barges and other marine equipment. They possess good resistance to salt water and their hard finish deters algae and other marine growth.

A suggested formula for a white marine paint is given in Table VIII.

Table VIII. Formulation for a Chlorinated Rubber Marine Paint

Ingredient	Parts by Weight
"Parlon," 20-cp. type.....	20
<i>Aroclor</i> 1254.....	6
"Rozyl 869".....	6
Titanium dioxide.....	25
Xylene.....	23
Hi-Flash naphtha.....	20
Total.....	100

Emulsion Paints

If chemical resistance is required on porous surfaces, *Aroclor* 1254 is often added to chlorinated rubber emulsion paints. The Hercules Powder Company reports that preferred water phases for such paints are either a 1 per cent distilled water solution of "Aerosol OT" or a 4 per cent distilled-water solution of sodium oleate. A lacquer-to-water ratio of 2.5 to 1 (by weight) is suggested for the complete emulsion. "Parlon" of any viscosity may be used. A typical paint phase for such an emulsion paint is given in Table IX.

Table IX. Formulation for Paint Phase of Emulsion Paint

Ingredient	Parts by Weight
"Parlon".....	28
<i>Aroclor</i> 1254.....	14
"Cumar P10".....	10
Xylene.....	24
Hi-Flash naphtha.....	24
Total.....	100

Adhesives

Chlorinated rubber adhesives with an *Aroclor* were developed originally for adhering labels to acid bottles because of their general resistance to chemicals. These adhesives are also of unusual interest because they are fire resistant. A typical formulation is given in Table X.

Table X. Formulation for Chlorinated Rubber Adhesive

Ingredient	Parts by Weight
"Parlon," 125-cp. type.....	20
<i>Aroclor</i> 1254.....	6
<i>Aroclor</i> 1260.....	6
Toluene.....	68
Total.....	100

Paper and Textile Coatings

Chlorinated rubber coatings with *Aroclor* are worthy of consideration for specific end uses in the paper and textile coating fields. In general, this type of coating is restricted by odor and taste. Unpigmented finishes seem suitable for certain fabrics used indoors, but not for exposure to high temperatures or direct sunlight.

Electrical Coatings

Because of their desirable electrical properties, these compositions are useful for insulating and protecting electrical wire and apparatus from moisture. With selected fungistats and waxes, coatings of this type are used to protect electronic equipment in the tropics against moisture and fungi. The fire resistance of these plastics is an added dividend in the electrical field.

Printing Inks

Printing inks requiring a fast drying time and chemical resistance are often based on chlorinated rubber compositions plasticized with an *Aroclor*. These inks are especially useful on soap wrappers and boxes, bottle labels and many other commodities because of their alkali resistance.

Other Resins and Plasticizers Compatible With Chlorinated Rubber

The resins and Monsanto plasticizers given in Tables XI and XII are compatible with chlorinated rubber, but none gives the over-all desired qualities attained by using an *Aroclor*. The strong points and limitations of each are known. If their use is necessary for specific applications in chlorinated rubber, more detailed information on them may readily be found.

Table XI. Resins Compatible with "Parlon"

"Amberol 801, 8061, ST-137, F7"	"Formvar"
<i>Aroclor</i> 1262, 5460	"Gelva 2.5"
"Aroplaz 920, 930, 935, 940"	"Glyptal 1247, 2450, 2454, 2458, 2464, 2466, 2500"
"Bakelite" XR-3180, XR-4503, XR-4006, BR-2963, XJ-9868, BR-1329, BR-3360"	"Lewisol 2L, 28, 33"
"Beckacite 1112"	Methyl methacrylate polymers
"Beckamine P-138, P-254"	"Neville R-3, R-10"
"Super-Beckamine 3501"	"Pentalyn A, G, M, X"
"Beckapol 1400"	"Petrex 1, 130H"
"Beckosol 1 (solid), 18, 31, 34, 40, 1329"	"Phenac 633-M"
"Beetle" Resin 227-8	"Rezyl 116, X315, 412, 775, 803, 807, 829, 869, 880, 1103"
"Clorafin 70"	Rosin
Copal	<i>Santolite</i> * MPH (sulfonamide-aldehyde resin)
"Cumar P10"	"Stabelite Ester 1, 2, 10"
Danimar	"Stabelite" resin
"Duraplex C-45-LV, C-48, C-49, C-50-LV, C-51, C-62, D-61, D-62, E-71, E-71-A, E-73"	"Super-Beckacite 1001"
East India gum	"Syntex H1, H3, H12, 17, 213, 22, 28, 29, 32, 36"
Ester gum	"Teglac 15, Z-152"
Ethyl methacrylate	"Velsicol AD6-3"
"Esterol 750"	"Vinsol"

Table XII. Monsanto Plasticizers Compatible with "Parlon"

<i>Aroclor</i> 1242	<i>Santizer</i> B-16 (butyl phthalyl butyl glycolate)
<i>Aroclor</i> 1254	
<i>Aroclor</i> 1260	<i>Santizer</i> M-17 (methyl phthalyl ethyl glycolate)
Dibutyl phthalate	Tricresyl phosphate
Diethyl phthalate	Triphenyl phosphate
Dimethyl phthalate	

*Santolite, Santizer, Monsanto Trademarks. Reg. U.S. Pat Off.

Toxicity

Animal toxicity studies and 20 years of manufacturing and use experience indicate that *Aroclor* compounds are not serious industrial health hazards. If the materials are heated to volatilization, ventilation should be provided to prevent inhalation of vapors. This is true of other major components of the formulation as well as the *Aroclor* compounds.

Repeated or prolonged skin contact should be avoided although there are few instances of skin irritation. Human patch tests with finished products containing *Aroclor* compounds have shown no irritation. Monsanto will furnish information on specific *Aroclor* compounds upon request.

Shipping Information

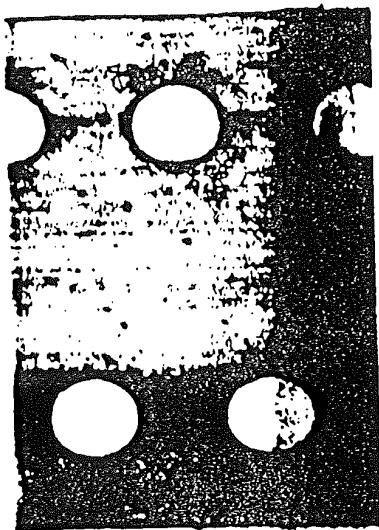
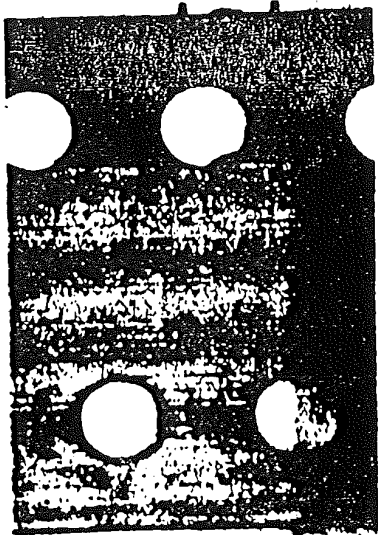
Regulations	— None
Standard Containers	— Steel and Fiber (<i>Aroclor</i> 1268, 5460) drums.
Rail Classification	
Chlorinated diphenyl (synthetic resin, liquid, NOIBN)	— <i>Aroclor</i> 1142, 1148, 1154, 1160, 1162, 1168, 1221, 1232, 1242, 1248, 1254, 1260, 1268
Synthetic resin, liquid, NOIBN	— <i>Aroclor</i> 1260 mix, 1262 mix
Synthetic resin, other than liquid, NOIBN	— <i>Aroclor</i> 2565, 4065, 4465, 5042, 5060, 5442, 5460
Truck Classification	
Synthetic resin powder, NOI	— <i>Aroclor</i> 2565
Synthetic resin, lumps or solid mass, NOI	— <i>Aroclor</i> 4065, 4465, 5042, 5060, 5442, 5460

The information contained in this bulletin is, to our best knowledge, true and accurate, but all recommendations or suggestions are made without guarantee, since the conditions of use are beyond our control. The Monsanto Chemical Company disclaims any liability incurred in connection with the use of these data or suggestions.

Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

Trademark Index

Trademark	Company
"Aerosol OT"	American Cyanamid Company
"Amberol"	Rohm & Haas Company
"Anisco Solv"	American Mineral Spirits Co.
"Aroplaz"	U. S. Industrial Chemicals Co.
"Bakelite"	Bakelite Company
"Beckacite"	Reichhold Chemicals, Inc.
"Beckamine"	Reichhold Chemicals, Inc.
"Beckopol"	Reichhold Chemicals, Inc.
"Beckosol"	Reichhold Chemicals, Inc.
"Beetle" Resin	American Cyanamid Company
"Cellosolve"	Carbide & Carbon Chem. Co.
"Clorafin"	Hercules Powder Company
"Cumar"	Barrett Division, Allied Chem. & Dye
"Duraplex"	Rohm & Haas Company
"Esterol"	L. Sonneborn Sons, Inc.
"Formvar"	Shawinigan Resins Corp.
"Gelva"	Shawinigan Resins Corp.
"Glyptal"	General Electric Company
"Hercolyn"	Hercules Powder Company
"Lewisol"	Hercules Powder Company
"Neville"	Neville Chemical Company
"Pentalyn"	Hercules Powder Company
"Petrox"	Hercules Powder Company
"Phenac"	American Cyanamid Company
"Rezyl"	American Cyanamid Company
"Solvasol"	Socony-Mobil Oil Company
"Solvesso"	Esso Standard Oil
"Stabelite" Ester	Hercules Powder Company
"Stabelite" Resin	Hercules Powder Company
"Super-Beckacite"	Reichhold Chemicals, Inc.
"Syntex"	Flintkote Company
"Teglac"	American Cyanamid Company
"Tollac"	Neville Chemical Company
"Troluol"	Anderson-Pritchard Oil Corp.
"Transite"	Johns-Manville Sales Corp.
"Velsicol"	Velsicol Corp.
"Vinsol"	Hercules Powder Company



A

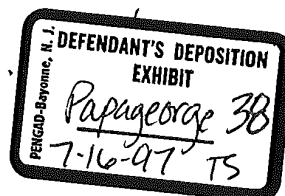
care
and
grooming
of
ASKAREL
TRANSFORMER



fluid

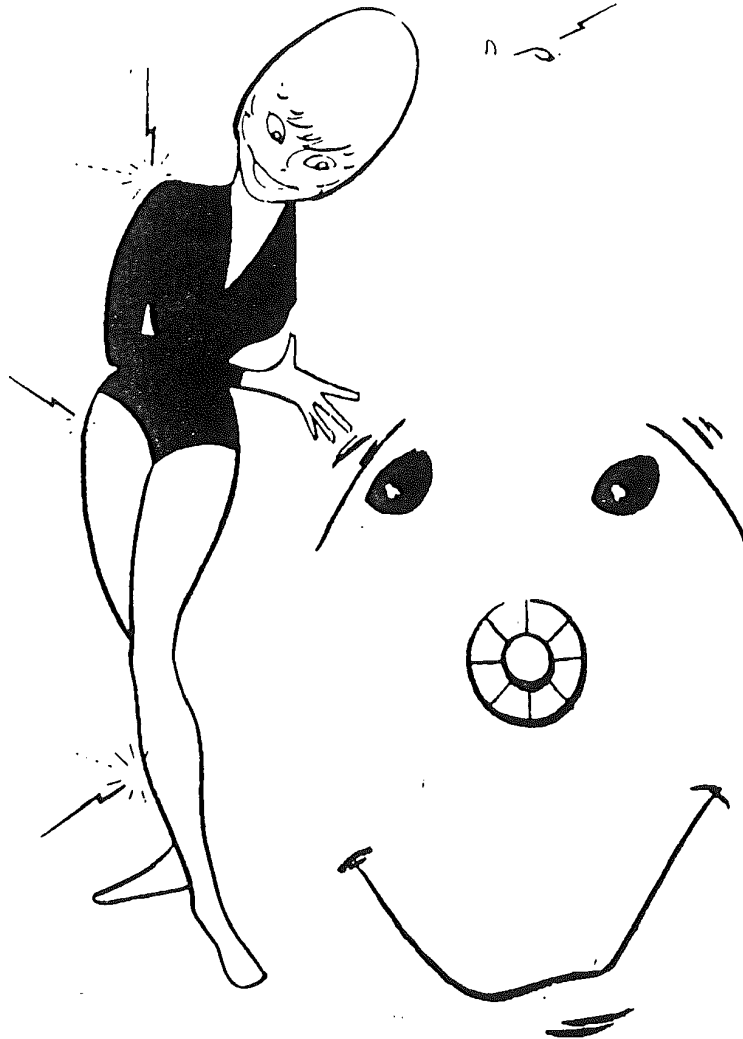
...to help you be sure your Askarel
liquid insulation is tip-top, and to keep
it in the best of operating health

REY 000875



YOUR "ASKAREL" TRANSFORMER SHOULD BE

your



REY 000876



LET'S
TALK
ABOUT
THE
"liquid
insulation"
IN
TRANSFORMERS

OILS — *that can burn*

There are quite a number of these. They are sold by oil companies; and these mineral oils are used in transformers where, if they catch fire, no great harm (besides the transformer itself) comes from the burning oil. If water gets into an oil-filled transformer, it tends to settle through the oil to the bottom. There are certain ways to check on the health of mineral oil insulation, too, but the "Check-points" are somewhat different than for askarel.

ASKARELS — *that cannot burn*

Although there are TWO types of askarel fluids (supplied under a number of brand names), actually they all have just one and the same basic ingredient: Monsanto's Aroclor® 1260. (If you want to know, Aroclor 1260 is hexachlorobiphenyl). And THIS is one of the world's best liquid insulations!

REY 000877

don't worry about "different kinds"

So, what are the two types? What's the difference? Simply this: they have different pour points and the tiny amount of "scavenger" chemical added to each is different. The Pyranol 1470 (General Electric) type has the lower pour point; it will still pour at 47° below (F.) zero. The Inerteen PPO (Westinghouse) type will pour down to 26° below (F.) zero. These two types each contain a tiny amount of a different additive; both additives are good and do their job. However, the additive in Pyranol type askarel can crystallize out a bit at 14° above (F.) zero. It does no harm; the crystals disappear after a while when the transformer warms up.

Other brand names, like Chlorextol (Allis Chalmers); Nollamol (Wagner Electric); Asbestol (Amertran Corp.); Saf-T-Kuhl (Kuhlman Electric) are either one type or the other. Some manufacturers simply call their fluid by the common descriptive name: askarel. But, transformer manufacturers who supply askarel fluids have sound reasons for favoring their own type. So, it's best to stay with your particular brand.

However, since basically askarel is askarel, there will be no difference in the operation of your transformer if IN EMERGENCY you would interchange or even mix the two types!

But askarel is NOT oil cannot, should not, must not be mixed with ordinary transformer oil. For one reason: the inside core materials used with mineral oil filled units get gooey with askarel. For another reason over 2% of mineral oil mixed into askarel "clobbers" its fire resistance. For another reason never mind! Don't mix or interchange askarel and oil.

"Askarel" liquid insulation is a very carefully-manufactured, highly pure, chemically made fluid. It does not vary in composition like the range of oils. AND . . . askarel is heavier than water. If water gets into askarel insulation, only a smidgeon (125 ppm) dissolves the rest floats on top.

Askarel is one of the most fire-resistant, chemically-inert, heat-stable liquids ever developed! You can be sure of this: askarel does not deteriorate when exposed to air, heat, hot metal; it does not break down over long use to form conducting or corrosive chemicals; it does not sludge or oxidize. Askarel will remain perfectly stable year after year after year unless broken down by exposure to severe arcing the kind that could set an oil transformer afire. The only real "enemy" of askarel is: contamination by water.

REY 000878

NOW LET'S TALK

year to year operation!

One of the most brain-y electrical engineers in the business once said: "The best 'maintenance' for askarel transformers is KEEP 'EM DRY, and leave them alone!"

This business of "keep 'em dry," however, whether your transformer is EITHER an oil-type or an askarel type, is the watchword! It takes some care. In fact, anything MECHANICALLY you can do to stop moist air breathing and condensation will be the best health insurance for your liquid filled transformer. Here are some of the questions that come up when you want to "keep 'em dry."

Is your transformer a **welded shell** or a gasket top?
(even the tightest gaskets can "breathe!")

Does your transformer run, stop; run, stop; run, stop?
(This hot-to-cold temperature cycling makes
the breathing faster and harder!)

Is air around it mostly cold and dry or hot and moist?
(Wouldn't it be great for automobiles and
transformers if there wasn't any such
thing as condensation!)

When you have "breathing" and high humidity -- you can cut back on check-ups if you fit the transformer with a drying device (all transformer makers offer these) or you can bleed dry nitrogen into the shell. Any mechanical steps you take to stop inside condensation will be double insurance on trouble-free operation.

Of course, if you are ordering a brand new transformer -- either oil or askarel type -- you can "design out" most of the moisture-entry points. Basically, you call for all-welded construction, including fins, pipes, and instrument connections AND a recessed gasket for the hand holes.

(If you or your electrical equipment supplier would like more complete details on tips to keep innards dry, we can send you a copy of: "Design Details For Moisture Protection of Liquid Insulation Transformers.")

So you'll be happy to learn that preventing moisture contamination is the only major health insurance you need provide for your askarel insulation.

REY 000879

CHECKING THE CHECKPOINTS

Now you are well on your way to being an "expert." Since you know that keeping tabs on **MOISTURE** is the *major* checkpoint on your askarel transformer, let's ask:

How do you keep tabs on moisture?

You do this by a periodic test of the askarel's dielectric strength.

Do not bother to check — or if you do — do not be misled or disturbed by relatively high power factor . . . or even a drop in volume resistivity.

(If you want to know why, you can read the fine print on the following page.)

The **DIELECTRIC STRENGTH** of the askarel is your major clue to the "health" (i.e. dryness) of your askarel transformer. Besides taking a good look at a sample of your askarel — dielectric strength is the only "test" you need actually run!

Here's why: the dielectric strength of askarel is sensitive to moisture; *not sensitive* to other ordinary contaminants (like metal dust, salts, dirt, etc.). The dielectric strength is also hurt by severe arcing, but you'll know that arcing is the culprit if the askarel has gotten noticeably black or has particles of sooty carbon floating in it. Unless you've had severe arcing (lightning, accidental overload, back surge, etc.), the dielectric strength is your "moisture indicator."

New askarel has a minimum dielectric strength of 35 KV at 25°C.; a maximum moisture content of 30 ppm. If you check the dielectric strength periodically, find that it is rapidly decreasing — this is your "clue" to moisture pick-up, arcing, or both. When the moisture content rises to 100-120 ppm (or over) — the dielectric strength will drop to 20 KV or less. That's your clue!

INSPECT FOR WATER CONDENSATION IN THE SHELL, AND "REFINE" THE ASKAREL.

As the operator, you will have to judge how often you want to check up on your askarel insulation. Steadily running, well-sealed askarel transformers have run as long as 25 years on the initial charge of askarel — and the dielectric strength still checked out at above 30 KV. **HOWEVER**, if the dielectric strength drifts downward to 25-20 KV at 25°C. — then it is time to "clean-up" the liquid insulation and to get rid of any water accumulation in the shell, too.

This askarel clean up is relatively simple; the askarel need **NOT** be discarded. **BUT MOST IMPORTANT . . .** if the dielectric strength drops rapidly over a short period of time, this shows rapid pick-up of water (or arcing).

When you take your sample for check-up — be sure to take it carefully (so it represents the *surface*) and handle the sample properly (so it doesn't pick up moisture in the sampling).

REY 000880

How



REY 000881

to check test^{*} your as

You'll be able to "take the pulse" of your askarel insulation with the following five simple rapid tests. (Three are simply "inspection-by-eye!") You can do these check-ups yourself or have the tests run by a local transformer service shop.

1 **COLOR** (by inspection) — New askarel is a clear, faint-yellow liquid. After long-term use, the color will gradually intensify to brown. Any color change, such as taking on a green, red or blue cast, indicates extraction. If you find a distinct *change in color*, the complete range of electrical characteristics should be checked to learn if the extracted color is the tell-tale for contamination.

2 **CLARITY** (by inspection) — New askarel is clear and should remain clear in service. Development of turbidity or cloudiness indicates contamination from water, insulation particles, metallic dust or dirt. Cloudiness or turbidity calls for a complete analysis. The exception to this would be cloudiness in a cold sample of *PYRANOL 1470*. This type askarel contains a scavenger additive which will "come out" of solution when cold (around 15°F.) and cause white turbidity and perhaps show salt-like deposits on the transformer shell. If this is noticed, heat the askarel sample to 150-200°F. for several hours and agitate. Upon heating, the Pyranol's additive will redissolve, as it will in a warm transformer.

3 **BLACK COLOR AND SMALL CARBON PARTICLES** (by inspection) — If the color of the sample is black, and especially if suspended carbon particles can be seen, this shows that the askarel has arced and should be discarded. You can also detect exposure to strong arcing *chemically*, with indicator paper. Simply dip a piece of moist blue litmus paper into the askarel. If the blue litmus turns red, there is excess acidity from arcing beyond the limit absorbed by the "scavenger" additive.

REY 000882

askarel insulation!

4 DIELECTRIC STRENGTH (by ASTM D901, D877) The dielectric strength is the most important; and it is a simple test to make. The dielectric strength of new askarel is 35 KV at 25°C. minimum. This value should not be allowed to fall below 25-20 KV. Contaminants (which may have pronounced effect on the power factor and volume resistivity) *usually do not lower askarel's dielectric strength.* Reduced dielectric strength almost always shows exposure to strong arcing or moisture contamination.

5 MOISTURE The moisture content of new askarel is 30 parts per million maximum. The moisture *saturation* level is about 125 ppm at ordinary temperatures. When the moisture content approaches 125 ppm (saturation level), the dielectric strength goes down. The moisture content of askarel should not be allowed to rise over 70 ppm; it should be held as near as possible to 30 ppm.

NOTE: If your sample shows 30-35 KV dielectric strength, you need not check for moisture. However, if you do check moisture, use the Karl Fisher Method, ASTM D-1533.

IF ANY OF THESE FIVE CHECK-UPS APPEAR ABNORMAL, CONTACT YOUR TRANSFORMER MANUFACTURER FOR COMPLETE ANALYSIS.

These simple tests will show you the condition of your askarel insulation, but only *indirectly* the condition of your transformer. They can be relied upon when the sample is carefully taken (so as not to "miss" water globules floating on the surface or adhering to the shell in the air space over the insulation). So, if you have taken mechanical precautions against moisture entry into your askarel transformers and can "Keep 'em dry!" these tests will be your assurance that, between checks, you can "Forget 'em."

*The American Institute of Electrical Engineers has published a comprehensive and informative guide titled "Proposed Guide for Maintenance of Transformer Askarel," AIEE No. 76, December 1958. This guide describes properties to be inspected and the ASTM method to be used.

Monsanto completely analyzes each production lot of transformer askarel by these methods prior to shipment. However, these official tests are **NOT ESSENTIAL** to the user of askarel transformers. When a complete analysis is required in a special case, the user should request it from the transformer maker, who in turn can call on Monsanto if needed.

REY 000883

GROOMING ASKAREL FOR RE-USE

If strong arcing has blackened askarel, throw it away; it costs less to replace arced insulation than to reclaim it. If there's been no arcing, but a low dielectric test shows moisture contamination, you'll find it is quite easy to refine the askarel back to good operating dielectric strength. Simply run the insulation through a dry, absorbent filter.

Most operators prefer a portable refining apparatus, such as a plate press, fitted with a dolly, (available from Sparkler, Mundelein, Ill.); or the earthen cartridge filter type, (available from Industrial Filter Corp., Lebanon, Ind.). Filter paper liners for the plate press are available from Carl Schleicher & Schuell Co., Keane, N.H.

Any flexible hoses and gaskets on the refining equipment should be lined with or made of materials that will not be softened by contact with askarel fluid. (Silicone or Teflon materials are suitable).

If you use a filter press, before refining it is advisable to oven dry the filter paper at 100°C. for a half hour to remove all moisture. If the askarel to be refined contains excessive moisture, circulate it hot (55-60°C.) through the filter fitted with the paper liners only first. Then, refit press with dry paper and load it with the absorbent earth.

The earth refining process is simple:

1. SPREAD DRY EARTH EVENLY OVER THE FILTER SURFACE.

Fine-mesh Attapulugus clay or Fullers earth, dried and activated by heating for 12 hours at 250°C. immediately prior to use, is highly efficient. The amount of earth used should be 0.1 to 0.2 per cent by weight of the askarel (askarel weighs about 13 pounds per gallon).

To deposit the earth evenly, stir one-third of the earth with a small portion of askarel in a clean container. Pump the mixture through the filter and follow with two more one-third portions.

2. PUMP THE HEATED ASKAREL FROM TRANSFORMER THROUGH FILTER.

Circulate askarel taken from near the top of the transformer, pass it hot (55-60°C.) through the filter and feed back through the bottom transformer outlet.

3. CONTINUE CIRCULATING THROUGH THE FILTER UNTIL ASKAREL IS CLEAR.

When the askarel is clear use the simple tests described earlier to check for restored dielectric strength.

4. CHECK THE TRANSFORMER AFTER REFINING.

After refining the askarel, the overall power factor and insulation resistance should closely approximate the values it would show with new askarel fluid.

If the overall power factor is more than 30-35 per cent (at 20°C. and 60 cycles) it is considered POOR and it is advisable to run a complete analysis of the entire insulation system.

REY 000884

POWER FACTOR & VOLUME RESISTIVITY

High power factor and low volume resistivity in transformer mineral oils are commonly regarded as "danger signals" that the oil has deteriorated and broken down chemically.

This is NOT true of askarel liquid insulation.

New, unused askarel shows these electrical values:

Power Factor: 0.05-0.2% @ 60 cycles, 20°C.
(about 1-2.0% @ 60 cycles 100°C.)

Volume Resistivity: 100-1000 x 10⁹ ohm-cm (@ 100°C., 500 V., DC., 0.1" gap)

Used askarel from SATISFACTORILY OPERATING TRANSFORMERS normally (and frequently) shows

Power Factor: 20 to 80% @ 60 cycles, 100°C.

Volume Resistivity: about 25 x 10⁹ ohm-cm (@ 100°C., 500 V., DC., 0.1" gap)

This relatively high power factor and relatively low volume resistivity of used askarel ARE TO BE EXPECTED. Even at these levels, the askarel's dielectric strength is STILL in the 30-35 KV range.

The reason is simple: askarel, unlike "oil," is a relatively polar liquid. The volume resistivity is sensitive to traces of conductive contaminants. However, even in the presence of large amounts of contaminants, the volume resistivity does not seem to fall below 10 x 10⁹ (ohm-cm). Yet the dielectric strength remains high, because intrinsically askarel remains a non-conductor.

To quote from Insulation Magazine, December 1961
DIELECTRIC LOSS YARDSTICKS

by John C. Botts, Manager Insulation Development Section, and Graham Lee Moses, Manager Services Engineering, Westinghouse Electric Corp., East Pittsburgh, Pa.

"Dielectric loss is a good comparative evaluation for some characteristics of insulation. It may be used for comparing similar samples of the same materials. It may not be used as an overall evaluation for comparing different materials." (i.e. "oils" and askarels)

Power factor is not an important criteria of askarel insulation efficiency IN A PROPERLY CONSTRUCTED TRANSFORMER.

However If improper construction materials or unpredictable foreign contaminants enter the system - high power factor (in the absence of moisture in the shell) can indicate improper construction.

REY 000885

sampling your ask

NOW . . . since you know that the DIELECTRIC STRENGTH is the most important checkpoint, and that (except for arcing) MOISTURE is the villain that saps dielectric strength . . . you want to make sure that your SAMPLE truly represents your askarel insulation.

TAKE YOUR SAMPLE AS CLOSE TO THE TOP OF THE LIQUID SURFACE AS POSSIBLE!

(Many large askarel transformers have a built-in sampling tube near the surface for convenient sampling. If additional sampling tube connections are contrived on to valves for easier sampling, make the tubes of clean glass, stainless steel, aluminum or tin for rigid types; and silicone or Teflon tubing for flexible types.)

Water floats on askarel. If there is any water in your transformer, it may collect in little puddles ON TOP of the askarel. AND, therefore, more water will probably be dissolved in the askarel near the top, where it contacts any collected condensation.

If you find low dielectric strength and high moisture in the askarel, you will probably want to thoroughly dry out the shell and take some mechanical steps to keep it dry.

When you take your askarel sample for testing, take the same precautions (but no more) that you take when sampling mineral oil:

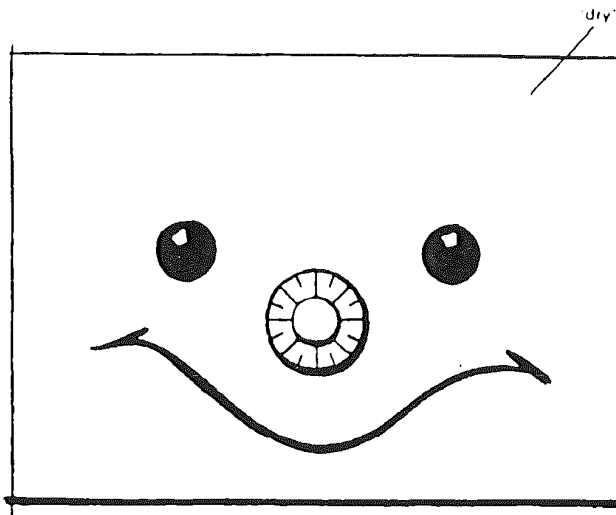
1. Select a dry day. Do not sample insulation on a warm, moist day when humidity exceeds 75%, and
2. Make sure that the askarel is at least as warm as the surrounding air. (Cold liquids can condense moisture from humid air.)
3. NEW containers for fluid sample

Your sample container should be a new and previously unused small mouth pint glass bottle fitted with a Bakelite screw cap fitted with an aluminum or tin bottle cap liner. Make sure that the new bottle does not stand around open to collect dust or moisture. Rinse the sample bottle and cap lining two or three times with askarel from the transformer; then fill it. When sample will be tested promptly, a clear glass bottle can be used. If sample is to be stored indefinitely, use an amber glass bottle or wrap clear glass with aluminum foil.

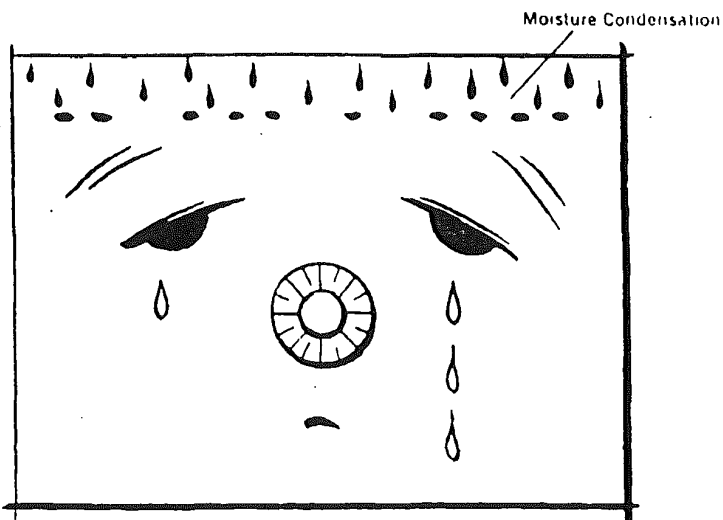
Whenever a sample is to be shipped to the transformer manufacturer (or to Monsanto) for complete analysis, the container must be a 5-pint amber glass bottle. For your convenience, various transformer manufacturers and Monsanto will send you the sample bottle filled with new askarel. You simply empty out the new askarel and re-fill bottle with your sample.

REY 000886

carel.....



Dielectric Strength: 30-35 KV
Moisture Content: 30-50 ppm



Dielectric Strength: 25-20 KV or less
Moisture Content: 125 ppm

REY 000887

THAT'S THE STORY:

keep 'em dry... let 'em alone!

But you might want these storage and handling "tips" to make you a complete transformer askarel expert.

STORE NEW ASKAREL IN A CLEAN DRY PLACE

Keep the 5, 30, or 55 gallon drums dry; turn them over on their sides to keep water off the drum head. (It can be sucked in by the drum "breathing.")

CLEAN UP SPILLAGE

Askarel can, if left standing, attack paint, rubber, or plastics. Absorb it from floors with sawdust, sweep, and then wipe dry. Use a rag wet with mineral spirits if you want to make sure it's all cleaned away.

TAKE ORDINARY PERSONAL CARE

Transformer askarel has been made, handled and used for over 30 years without causing toxic or other ill effects. Askarel can be handled in the same manner as insulating mineral oil. As with mineral oil, there may be some people allergic to askarel, so prolonged skin contact should be avoided where possible.

When accidentally spilled or splashed on the skin, askarel does not present an acute hazard nor will it cause serious skin irritation. Simply wash it off with soap and water. If work clothes become impregnated with askarel, they should be removed and washed.

Eye contact may cause temporarily painful irritation but NO PERMANENT DAMAGE to the tissues or sight. Flush the eye with large amounts of water. A drop of castor oil may be put in the eye. As with all eye first-aid, refer to a physician who will treat the eye with an ointment.

Ordinary, infrequent exposure to askarel vapors will not cause any ill effects. However, prolonged exposure to strong vapors should be avoided. If hot fluid is to be handled in a closed or confined area, provide ordinary exhaust ventilation. Harmful concentrations of askarel vapors are easily detectable by the smarting of the nose or eyes.

Should hot askarel (above 100°C.) have to be handled in the open in a confined, unventilated area - it is advisable to wear organic canister-type masks as supplied by Mine Safety Co. - Pittsburgh, Pa.

REY 000888

(AS FAR AS EQUIPMENT CAN BE!)

best friend!

Since "askarel" type transformers were first made in 1930, few pieces of electrical equipment have equalled these "juice controllers" in trouble-free service. The name "askarel" applies to the liquid insulation that fills askarel type transformers. And "askarel" is a general name for a unique kind of chemical classified as a halogenated hydrocarbon. But, don't let this chemical jargon bother you one bit. After you read this little pamphlet, you'll be an EXPERT on operating askarel transformers; you'll know all about this wonderful liquid — askarel insulation -- because it's all very simple.

however!

Since many engineers and maintenance operators work with BOTH askarel and transformer "oils," you will want to remember that askarel is *different* from mineral oil . . . and you'll want to know the simple ways to "check up" on the health of your askarel transformer.

That's the reason for this pamphlet. First, to tell you that your askarel transformer, in addition to being FIRESAFE, can be the most trouble-free piece of equipment you operate. Second, to give you the few simple facts that will make you an expert on the "whys" and "wherefores" of the easy maintenance. Knowing the facts given on the following pages, you will keep your askarel (and transformer) operating at trouble-free, top performance, year, after year, after year.*

****We own one that has been operating as faithfully as a heart beat for 28 years!***

REY 000889

Monsanto also supplies:

Pydraul AC All synthetic fire-resistant compressor lubricant.

Pydraul All synthetic fire-resistant hydraulic fluids.

Thermal Fluid Fire resistant, non-vaporizing heat transfer fluid.

Coolanol Dielectric coolants for high power electronic circuits.

Fluid OS-59 Dielectric for high frequency power transformers.



MONSANTO CHEMICAL COMPANY

Aviation and Special Fluids Department
Organic Chemicals Division
St. Louis 66, Missouri

Askarel transformer fluids can be ordered directly from any one of these Monsanto sales service centers

Atlanta

Boston

Chicago

Cincinnati

Cleveland

Detroit

Houston

Los Angeles

Minneapolis

New York

Pittsburgh

St. Louis

San Francisco

Seattle

Syracuse

Wilmington

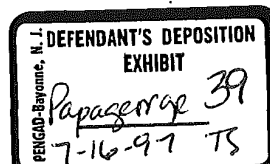
REY 000890

7-111-0442-10 PRINTED IN U.S.A.

DATA SHEET FOR TOXICOLOGICAL AND SAFE HANDLING INFORMATION

(Please Complete Applicable Sections)

1. Product name, number, synonym: Pydraul 150
2. Manufacturer's name: Monsanto Chemical Company
3. Manufacturer's address: 800 N. Lindbergh Boulevard, St. Louis 66, Missouri
4. Procedure in Case of Breakage or Leakage: Clean up as with any lubricating oil or hydraulic fluid.
5. Transportation and Storage Requirements: -----
6. First Aid Treatment:
 - a. Skin contact: No serious immediate effect. Wash with soap and water to avoid prolonged and repeated skin exposure.
 - b. Eye contact: Flush for at least 15 minutes with water. Get medical attention. Physicians have used 1% pontocaine solution and ophthalmic cortisone acetate solu. to relieve smarting and irritation.
 - c. Inhalation: Low degree of hazard due to low volatility at normal temperature.
 - d. Antidote in case of swallowing: Induce vomiting and refer to physician.
7. Physiological Properties:
 - a. Acute oral toxicity: Rats - lethal dose greater than 28,500 mg/kg.
 - b. Local effects upon eyes: In animals - mild irritation. Mild irritant to human but with pain out of proportion to degree of irritation.
 - c. Local effects upon skin: Classed as mild skin irritant. Dissolves natural fat and oils on surface of skin.
 - d. Estimate of acute hazard by inhalation (volatile materials): Low degree of hazard due to low volatility at normal temperature. Laboratory animals survived six hours exposure to atmosphere saturated with vapors.
- (See National Safety Council recommendations for toxicity evaluations)
- e. Warning Properties (Odor, irritation to eyes, nose, or throat): Slight characteristic odor.
- f. Estimated threshold limit value (if not on current list by American Conference of Governmental Industrial Hygienists): -----
8. Chemical and Physical Properties:
 - a. Specific gravity (water = 1) 1.125 @ 25°C.
 - b. Vapor density (air = 1) > 1
 - c. Vapor pressure mm Hg XXXXX 0.1 mm @ 200°F.
 - d. PH Neutral



e. Corrosive action on air materials such as: aluminum; magnesium; p glass; rubber; lacquers; enamels; fabrics: Not corrosive.

f. Does the material decompose violently when exposed to air? Water? Heat? Strong oxidizers? No.

g. For mixtures or impurities give the percentage composition of ingredients: CONFIDENTIAL - A phosphate ester base fluid containing chlorinated hydrocarbons.

Compound

Percent

NOTE: Please be specific. For example: it is important to know whether or not the alcohol portion contains methanol; the aromatic portion, benzene; the chlorinated portion; carbon tet; etc.

h. Does the material generate heat through polymerization? No.

9. Precautions for Normal Conditions of Use: Avoid repeated, prolonged inhalation of vapors or mists. Avoid contact with eyes or prolonged contact with skin.

10. Recommended Protective Equipment: None should be required if Pydraul 150 is used as recommended.

11. a. Flash point °F: Closed cup Fire resistant Open cup 425° F If F. P. changes during evaporation, give data: _____

b. Explosive limits (% vol. air): Lower _____ Upper _____

c. Susceptibility to Spontaneous Heating: Yes _____ No X

d. Fire point °F Fire resistant Auto ignition temperature °F Above 1100° F.

e. Vapor density > 1

f. What products might be formed in the event of fire or abnormal temperatures? CO, CO₂, phenolics, HCl.

g. Suitable extinguishing agents: Fire resistant

12. Information Furnished By: Mr. Elmer P. Wheeler

Title: Assistant Director, Medical Department

Company: Monsanto Chemical Company

Address: 800 North Lindbergh Boulevard

Date: St. Louis 66, Missouri

March 31, 1961

MONS 098019

NOTE: Information in regard to this material's composition will be treated as confidential and used only for the purpose of protecting the health and safety of ARO employees and the safeguarding of its property.

DATA SHEET F TOXICOLOGICAL AND SAFE HANDLING INFORMATION
(Please Complete Applicable Sections)

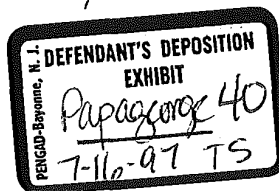
1. Product name, number, synonym: PYDRAUL AC
2. Manufacturer's name: MONSANTO CHEMICAL COMPANY
3. Manufacturer's address: St. Louis, Missouri
4. Procedure in Case of Breakage or Leakage: Clean up as with lubricating oil.
5. Transportation and Storage Requirements: No special requirements.
6. First Aid Treatment:
 - a. Skin contact: Wash with soap and water.
 - b. Eye contact: Flush with copious quantities of water. Get medical attention. Physicians have used 1% pontocaine solution and ophthalmic ~~XXXXXX~~ cortisone acetate solution to relieve smarting and irritation.
 - c. Inhalation: Due to low volatility, inhalation is no hazard.
 - d. Antidote in case of swallowing: Induce vomiting and refer to physician.
7. Physiological Properties:
 - a. Acute oral toxicity: Rats - ~~LD₅₀~~ approximately 40,000 mg/kg.
Rabbits - MLD 3500 to 4500 mg/kg.
 - b. Local effects upon eyes: In animals - mild irritant. Mild irritant to humans but with pain out of proportion to degree of irritation.
 - c. Local effects upon skin: Classed as mild skin irritant. Dissolves natural fats and oils - similar to paint thinner.
 - d. Estimate of acute hazard by inhalation (volatile materials): Low degree of hazard due to low volatility at normal temperature. Laboratory animals survived six hrs. exposure to atmospheres saturated with vapors.

(See National Safety Council recommendations for toxicity evaluations)

 - e. Warning Properties (Odor, irritation to eyes, nose, or throat): Mild pleasant odor. Massive exposure to mist, aerosol or vapors irritating to eyes.
 - f. Estimated threshold limit value (if not on current list by American Conference of Governmental Industrial Hygienists): -----
8. Chemical and Physical Properties:
 - a. Specific gravity (water = 1): 1.340 to 1.360
 - b. Vapor density (air = 1): 11.2
 - c. Vapor pressure mm Hg at 25°C: 2×10^{-5}
 - d. PH: Neutralization Nbr. 0.15 max.
(PH not determined on fluid)

11-1700-R1

MONS 071293



WATER_PCB-SD0000064367

- e. Corrosive action on aircraft materials such as: aluminum; magnesium; plexiglass; rubber; lacquers; enamels; fabrics: Not corrosive. May soften some lacquers, enamels or other synthetic surfaces.

- f. Does the material decompose violently when exposed to air? Water? Heat? Strong oxidizers? NO

- g. For mixtures give the percentage composition of ingredients:

Compound	Percent
PYDRAUL AC is a proprietary product and we are under obligation not to disclose its composition.	

NOTE: For example, generalizations such as petroleum hydrocarbons, alcohols, ketones, chlorinated hydrocarbons, etc. are not adequate for toxicological evaluation. Proper chemical names must be known.

- h. Does the material generate heat through polymerization or condensation? No

9. Precautions for Normal Conditions of Use: Avoid repeated, prolonged inhalation of vapors or mist. Avoid contact with eyes or prolonged contact with skin.

10. Recommended Protective Equipment: None should be required if Pydraul AC is used as recommended.

11. a. Flash point °F: Closed cup Not used; Open cup 470°F; If F.P. changes during evaporation, give data: _____

- b. Explosive limits (% vol. air): Lower Unknown; Upper Unknown

- c. Susceptibility to Spontaneous Heating: Yes _____; No X

- d. Fire point °F 725°F; Auto ignition temperature °F 1080°F

- e. Vapor density 11.2 compared to a value for air of 1.

- f. What products might be formed in the event of fire or abnormal temperatures? CO, CO₂, phenolics, HCL.

- g. Suitable extinguishing agents: Same as for any fire resistant synthetic material.

12. Information Furnished By: Mr. Elmer P. Wheeler

Title: Assistant Director, Medical Department

Company: MONSANTO CHEMICAL COMPANY

Address: 800 North Lindbergh Blvd., St. Louis 66, Missouri

Date: January 15, 1963

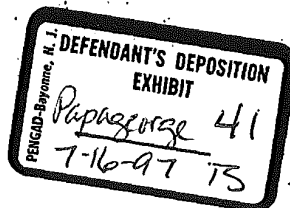
NOTE: Information in regard to this material's composition will be treated as confidential and used only for the purpose of protecting the health and safety of Boeing employees and the safeguarding of its property. The completed form should be mailed to Industrial Hygiene, Boeing Airplane Company, Seattle 24, Washington. Disregard if previously accomplished.



Monsanto ASKAREL

Inspection and Maintenance Guide

REVISED SEPT. 1981



REY 000919



ASKAREL

Inspection and
Maintenance Guide

REY 000920

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SECTION A TRANSFORMER ASKAREL

I. INTRODUCTION:

This manual describes the operating characteristics of transformer *askarel liquid* insulation and how it differs from mineral oil.

The information given is based on facts gathered by Monsanto over 30 years as producer of askarel, plus knowledge gained from the experience of transformer manufacturers and users. This guide is provided to outline the very simple maintenance required for askarel fluid in "modern" transformers and to offer suggestions for the sealing and maintaining of askarel in old units. By following this guide, users will obtain maximum service from askarel insulation with a reasonable minimum of maintenance. If questions arise relating to the designing and building of transformers — these should be referred to regular transformer suppliers.

Monsanto gratefully acknowledges the assistance, guidance, and the contributions of certain data by the following:

Frank M. Clark.....	General Electric
Edward L. Raab.....	General Electric
James G. Ford.....	Westinghouse Electric
George Shombert, Jr.....	Allis Chalmers

II. HISTORY OF TRADE NAME TYPES

"Askarel" is the generic name for non-combustible (fire-resistant) liquid insulation. In this respect, the insulation is completely different from ordinary transformer mineral oils. Transformer askarel is marketed by Monsanto. Whatever the trade-marked brand, the askarel contains Monsanto's Aroclor (chlorobiphenyl) . . . one of the best liquid insulations developed by science. This inert compound is chemically stable, fire-resistant, heat stable, non-corrosive, and has high dielectric strength under the operating conditions encountered in transformers.

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Askarel liquid insulation is made by thinning Aroclor 1260 with trichlorobenzene or tri-, tetrachlorobenzene mix. The first transformer askarel was made in 1932, in accordance with General Electric Company's patents, and was trademarked Pyranol 1488. Westinghouse, too, offered this askarel insulation in 1936 under their trademark Inerteen.

In the mid-1940's, as shown in the following table, tin tetraphenyl was added to General Electric's Pyranol to scavenge hydrogen chloride. Shortly thereafter, Westinghouse added phenoxy propene oxide to Inerteen for the same purpose. In 1963, General Electric replaced tin tetraphenyl with a diepoxide scavenger. This new formula, which replaces previous Pyranols, is called Transformer Pyranol A13B3B. Thus, today the two commercial types of formulations are General Electric's Transformer Pyranol A13B3B type and Westinghouse Inerteen PPO (7336-9) type.

The composition changes made in transformer askarel formulations are shown in Table I.

Table I THE COMPOSITION OF TRANSFORMER ASKARELS						
	Pyranol				Inerteen	Inerteen PPO
	1488	1467	1470	A13B3B	Inerteen	(7336-9)
Year Introduced.....	1932	1944	1952	1963	1936	1945
Ingredients:						
Aroclor 1260.....	60	60	45	45	60	60
Trichlorobenzene.....	40	40	40	40	40	40
Tetrachlorobenzene.....			15	15		
Tin tetraphenyl.....		0.125	0.125			
Phenoxy propene oxide.....						0.20
Diepoxide.....				0.125		

OTHER BRAND NAMES

Various electrical equipment manufacturers use other trade-marked names for askarel liquid insulation, such as Chlorextol (Allis-Chalmers); Noflamol (Wagner Electric); Saf-T-Kuhl (Kuhlman Electric). These askarel insulating liquids are one or the other of the two standard formulations. Still other manufacturers, who designate their insulation only by its generic name, askarel, assign it a number or code. By this number, Monsanto knows whether to furnish Pyranol A13B3B or Inerteen PPO (7336-9) type formulation to the user.

III. OFFICIAL TRANSFORMER ASKAREL SHIPPING SPECIFICATIONS

The official shipping specifications for the two modern transformer askarel formulations are shown in Table II.

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Table II

OFFICIAL TRANSFORMER ASKAREL SHIPPING SPECIFICATIONS

Typical Properties	General Electric Co. Transformer Pyranol A13B3B	Westinghouse Transformer Inerteen PPO (7336-9)
Color, APHA	150 max.	150 max.
Condition	Clear	Clear
Water content, ppm (ASTM D1533-60)	30 max.	30 max.
Acidity, mg. KOH/g. (ASTM D974-55)	0.014 max.	0.014 max.
Dielectric Strength, 25°C., 0.1 inch gap (ASTM D877-49)	35 KV, min.	35 KV, min.
Dielectric Constant, 100°C., 1 KC (ASTM D924-49)	3.8 to 4.3	3.7 to 4.0
Volume Resistivity, 100°C., 500 volts DC 0.1 inch gap, 10 ⁹ ohm-cm.	100	100
Inorganic chlorides, ppm. (ASTM D1821 and G.E. Method E4C41B)	0.10 max.	0.10 max.
Refractive index, 25°C. (ASTM D901-56)	1.6075 to 1.6085	1.6137 to 1.6147
Viscosity at 37.8°C. (ASTM D88-56) Saybolt Universal Seconds	41 to 45	54 ± 2
Pour point °C. (ASTM D-97-57)	—44 or lower	—32 or lower
Specific gravity 15.5/15.5°C. (ASTM D287)	1.560 to 1.571	1.560 to 1.568
Burn point (ASTM D92)	None to boiling	None to boiling
Distillation range (ASTM D20-56) corrected for stem and barometric pressure	1st drop 210°C. min.	1st drop 200°C. min.
	35% 240 to 256	40% below 270°C.
	55% 290 to 330	90% 395 to 415°C.
	65% 385 to 400	
	95% 395 to 415	
Fixed chlorine	60.5 ± 5%	59.1% min.
Corrosion test	After heating with aluminum for 6 hrs. at 200 to 220°C., the aluminum must not be corroded on either visual or weight inspection and the askarel should meet the following specifications:	
Color, APHA	200 max.	200 max.
Acidity, mg. KOH/g.	0.014 max.	0.014 max.
Inorganic chlorides ppm.	2.0 (tent.)	2.0 max.
Condition	Clear	Clear
Scavenger content	0.115 to 0.135%	0.18 to 0.22%
Arc formed gases	Diepoxide	phenoxy propene oxide
	Less than 1.0% of total combustible gases including carbon monoxide, hydrogen and volatile hydrocarbons.	
Coefficient of Thermal Expansion (ASTM D1903), CC./CC./°C.	0.0007	0.0007

The above two formulas are used in modern transformers. There are a number of units in service dating back to 1933 with askarels of somewhat different compositions. These will be compatible with the above modern formulations.

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IV. INTERCHANGEABILITY AND STABILITY

A. Interchangeability:

The two general types of askarel insulation shown in Table II can be either mixed or interchanged and there will be no difference in the operation of the transformer. However, askarel insulation *must never be mixed* with mineral oil.

Over 2% mineral oil in askarel begins to lower its fire resistance. Further, materials of construction in the transformer that are compatible with askarel may not be compatible with oil and vice-versa. For example: a significant amount of askarel in a transformer built for mineral oil will attack gaskets, adhesives, core bindings, impregnating varnishes, etc.

B. Stability:

Askarel liquid insulation is highly pure, fire-proof liquid made under close chemical control. It does not vary in composition like the commercial range of mineral oils.

Askarel does not deteriorate when exposed to air, heat, hot metal; it does not break down over long use to form conducting or corrosive chemicals; it does not oxidize or sludge. Askarel will remain perfectly stable year after year unless broken down by exposure to severe arcing.

The only real "enemy" of askarel is *contamination by water*. Keeping askarel water-free will insure long-time service.

Askarel is heavier than water. If water gets into askarel insulation, only a tiny amount (125 ppm) dissolves — the rest floats on top.

V. DIRECTIONS FOR HANDLING

A. Keep Dry:

In handling, storing, sampling, inspecting askarel — and in operating askarel transformers — take every precaution to guard the askarel insulation from exposure to high humidity and moisture contamination. Keep 5, 30, or 55 gallon drums of askarel dry; lay stored drums on their sides with the bung at the highest point from floor to keep water off the drum head (which can be sucked into the askarel by the drum "breathing"). This precaution is not necessary when drums are stored indoors, which is the preferred way of storing.

B. Use Ordinary Personal Precautions:

Transformer askarel has been made, handled, and used for over 30 years without causing toxic or other ill effects. It can be handled with only minor precautions. If accidentally spilled on hands, no serious skin irritation will occur. However, liquid askarel has a solvent action (similar to paint thinner) on the fats and oils of the skin and prolonged contact may lead to drying and chapping of the skin.

In case of contact, wash off the skin with soap and water; remove and dry clean saturated clothing. Clean up spills with rags, sawdust or absorbent clay. Eye contact may result in painful irritation but no permanent damage to tissues. If askarel gets in the eyes, flush with large amounts of water. As with all eye first-aid, refer to a physician. To relieve irritation, physicians have used a 1% Pontocaine as well as ophthalmic cortisone acetate solution, or castor oil.

Infrequent exposure to askarel vapors will not cause ill effects. However, prolonged exposure to high vapor concentrations should be avoided. If hot askarel must be handled in a closed or confined area, provide the area with ordinary exhaust ventilation — or — wear an organic cartridge respirator approved by the U. S. Bureau of Mines.

VI. EXPECTED SERVICE LIFE

Properly designed and installed askarel transformers will give trouble-free service for a minimum of 30 years. Since their introduction in 1932, the manufacturers report finding the over-all failure rate to be less than 0.5% for all units under test and service conditions. The Edison Electric Institute's report (1956-1958) on their member utilities publishes the failure rate for askarel transformers as 0.13 per hundred banks per year. Even the rare reports of failure are invariably found to be due to improper sealing that allows moisture to enter.

VII. DIELECTRIC STRENGTH — MOISTURE RELATIONSHIP

The dielectric strength of askarel is highly sensitive to excess moisture; not sensitive to ordinary dissolved contaminants. While the dielectric strength can also be lowered by severe arcing, askarel turns noticeably black or has particles of sooty carbon floating in it if arcing has occurred. Then the transformer should be repaired and the askarel replaced.

New askarel has a minimum dielectric strength of 35 KV at 25°; a maximum moisture content of 30 ppm. If the dielectric strength is checked periodically and decreases significantly — this indicates moisture pick-up, arcing, or both. When the dielectric strength has dropped to 26 KV or less, an analysis for water is necessary. If water is found in excess of 100 ppm at 25° C., its source should be located and corrections made.

When the moisture content approaches 125 ppm (saturation level), the dielectric strength of askarel drops below the value required for efficient insulating. The moisture content should not be allowed to rise over 70 ppm; it should be held as near as possible to 30 ppm. Maintaining a low moisture level will assure high dielectric strength and top operating efficiency.

Table III shows the relationship of dielectric strength vs. moisture and Table IV indicates the approximate water solubility limits in askarel and mineral oil.

Table III RELATION OF "BREAKDOWN STRENGTH" TO AMOUNT OF DISSOLVED WATER IN ASKAREL AND MINERAL OIL		
Water Content (PPM)	Breakdown Voltage (ASTM)	
	Askarel	Mineral Oil
0	70 KV	50 KV
20	55	39
40	47	30
60	40	26
80	38	22
110	10	5

Table IV APPROXIMATE SOLUBILITY OF WATER IN TRANSFORMER ASKAREL AND MINERAL OIL			
°C.	Temperature	°F.	Amount of Water (PPM) Dissolved
			Askarel Mineral Oil
-30		-22	8 8
-20		- 4	16 10
-10		14	28 13
0		32	41 20
10		50	65 33
20		68	94 58
30		86	128 85
40		104	170 130

TURBIDITY

... may be the visual sign of undissolved water, or may indicate contamination from core materials, dirt, or deteriorating construction materials. Cloudiness may also result from cold precipitation of tin tetraphenyl "scavenger" that was used in the earlier Pyranols. This scavenger begins to come out of solution around 15°F. above zero. To redissolve it requires heating to 150 - 200°F. and agitation.

High dielectric strength will quickly indicate that any turbidity present is not moisture; that the insulating efficiency of the askarel is still excellent. However, if the dielectric strength is below 26 KV, moisture should be determined, using the Karl Fischer method (ASTM D1533-60).

The dielectric strength test for askarel serves primarily as an indicator for moisture. It is by far the most important maintenance test for transformer askarel.

VIII. TYPICAL VALUES FOUND IN ASKAREL FLUID UNDER VARIOUS USE CONDITIONS

Table V gives the entire spectrum of properties that are typical for freshly-made transformer askarel as it goes through the various normal and abnormal conditions of use.

The data in Table V are in terms of *only* the askarel *fluid* and do not refer to insulation resistance or power factor measurements on the over-all transformer insulation.

Several utilities studying the power factor values of the over-all transformer insulation system indicate that the unit power factor of a new askarel transformer should range from 1% to not over 5%. This would generally correspond with the askarel *fluid* properties as given under heading "B".

Table V
TYPICAL VALUES FOUND IN ASKAREL FLUID UNDER VARIOUS CONDITIONS OF USE

	A	B	C	D	E	F
	New askarel	Askarel in properly* built new or rebuilt units prior to use.	After normal operation; a survey of 50 units, most 2-5 yrs. old; some 10.	Non-arced but slightly contaminated askarel in improperly* built units, new or slightly used.	Same askarel as in Column D — after refining.	Heavily arced askarel due to neglect and internal electrical malfunction.
Inspection Check Points						
Color	Light straw	Light straw	Light straw	Can have foreign shades, blue, green, red cast.	Foreign shades remain showing extraction of oil soluble color.	Black
Clarity	Clear, free from particles	Clear, practically free from particles	Clear, trace of particles	Clear, slight amount of particles	Clear, free from particles	Contains carbon particles
Moisture 25°C.	30 ppm	30 ppm	10-70 ppm all dissolved water	20-100 ppm all dissolved water	30 ppm	Near 125ppm saturation level — plus possible undissolved water
Dielectric Strength 25°C., 0.1" gap	35 KV minimum	35-48 KV	35-45 KV	30-42 KV	40-45 KV	5-15 KV
Volume Resistivity 100°C., 500 Volts, DC., 0.1" gap	100 x 10 ⁹ ohm-cm. minimum usually 500-1,500	40 x 10 ⁹ ohm-cm. minimum usually at least 100 x 10 ⁹	15-400 x 10 ⁹ ohm-cm.	about 5 x 10 ⁹ ohm-cm.	at least 1,500 x 10 ⁹ ohm-cm.	about 3 x 10 ⁹ ohm-cm.
Power Factor:						
100°C. 60 cycles	2-5%	10-25%	10 to near 80%	30 to 100%	2-5%	100%
25°C. 60 cycles	0.05-0.1%	0.5-2%	0.5 to near 10%	about 7 to over 15%	0.1-0.2%	at least 25%

*A properly built transformer is defined as one in which the materials of construction are chemically and electrically compatible with askarel.

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Starting ideally with situation "B", it is normal to expect the power factor of the fluid in a satisfactorily operating askarel transformer to increase as shown under heading "C". The "over-all" power factor of the transformer in normal service is expected to rise, but preferably not much beyond 5%. In this normal situation, the moisture level of the askarel fluid and its dielectric strength will be satisfactory, as shown in heading "C".

Occasionally the power factor of a non-arced, satisfactorily-operating askarel transformer is found to be relatively high, i.e., 15%. In this case, the power factor of the askarel fluid will also be high, perhaps as high as 50% at 20°C. and 60 cycles.

It is not good practice merely to note that high power factor of the askarel fluid is to be expected. The important step is to check dielectric strength and note whether there has been a downward trend. A downward trend in dielectric strength very likely indicates moisture entrance and should be confirmed by a Karl Fischer test for water.

The importance of any abnormalities in dielectric strength and moisture content of the askarel fluid cannot be overemphasized! Where abnormal values for the dielectric strength or moisture content occur, the power factor of the transformer can be expected to be abnormally high; the expected high power factor of the askarel fluid will induce this.

The indication that a high power factor on the transformer and on the fluid is due to contamination can be verified by earth refining the askarel fluid and noting whether after refining the test results correspond with heading "E".

Assuming no mechanical defect or arcing, if the power factor of a new askarel transformer is relatively high, the power factor of the fluid will also be high, giving the situation under heading "D". This reflects contamination that should have been removed by the manufacturer of the transformer.

In absence of mechanical defect, where there are no abnormal losses in dielectric strength, and no moisture pick-up in non-arced askarel — the use history shows that a relatively high power factor for the askarel fluid (as compared with mineral oil) is to be expected. Normally, high power factor is due to contamination and not deterioration of the askarel operation.

As shown by F. M. Clark in his book, "Insulating Materials For Design and Engineering Practice," John Wiley & Sons, N. Y., 1962 — activated alumina can be used in the circulating system to bring the power factor down and keep it as low as possible.

IX. CHECK POINTS FOR MAINTAINING ASKAREL INSULATION

A. General Considerations:

Modern askarel transformers with welded construction or silicone gaskets for hand hole-cover, switch and terminal compartment covers, with properly constructed bushings require little or no maintenance. With properly constructed transformers, annual or semi-annual visual inspection and dielectric strength test of the askarel fluid should suffice for routine maintenance checking over many years of service.

However, many askarel units were installed in the early 1930's — before the development of some of the better modern gasketing materials and before improved designs were developed for sealing out moisture. Such early units should be, and can be, modernized. Leaky or deteriorated gaskets should be replaced. If the askarel has become contaminated, it should be reconditioned. At the same time, a general clean-up of the unit and possible refinishing may be desirable.

If it is not convenient to take an old transformer out of service for general repairs, leaky gaskets can be sealed temporarily by painting over the leaky area with epoxy cement.

A survey of users indicates a good number of early-built askarel transformers (over 20 years old) are kept in continuous service in critical installations by the following steps (instead of modernization).

The operating units are equipped with compound pressure gauges for reading pressure above and below atmospheric. Positive pressure is maintained on the shell by introducing nitrogen at 2 to 3 pounds above atmospheric. Regular workmen in the area daily record the temperature and pressure. If a sudden pressure drop is noted more nitrogen is introduced and the gaskets are checked for leaks with soap solution. Leaks are sealed by applying epoxy cement.

B. Modern Sealing Procedures:

Transformer purchasers should specify the following modern techniques for sealing:

1. **Welding Construction:** Covers, radiator connections, switch and terminal housings, instrument connections, etc. should be welded.
2. **Bushing Connections:** The most satisfactory bushings are the type with rolled-on flanges and two ring seals rolled into a depression in the porcelain — sealed with silicone rubber rings held under compression. Metal-to-glass or metal-to-porcelain sealed bushings are also satisfactory.

If for any reason the above type bushings cannot be used then use a porcelain or glass bushing with a silicone or Viton gasket retained in a groove. The gasket can be either rectangular or circular cross section, usually $\frac{1}{4}$ inch thick.

3. **Small Size Connections:** When not possible to weld, small size connection seals should be made with Flexitallic stainless steel rings. The surfaces must be machined and parallel. The filler between the steel laminations of the Flexitallic ring should be either silicone or Viton.

4. **Gaskets For Hand-Hole Covers:** Modern design specifies silicone gaskets. Such gaskets must be retained in a groove. The groove preferably is machined into the flange or cover. However, it can also be formed by welding concentric steel strips to the flange or the cover.

Generally the gaskets should be $\frac{5}{16}$ to $\frac{1}{2}$ inch thick for covers, depending on the depth of the groove. A rectangular section is usually used.

The silicone material should be Dow-Corning No. 50 Silastic or equivalent. This is a low compression set material. For best sealing 20 to 25% compression is recommended, with ample clearance in the groove to allow for this compression.

No cement is required. With reasonable care the gasket is removable without damage and is reusable.

Silastic 50 is slightly swelled by askarel which contributes to the tightness of the seal. It is not deteriorated by askarel fluid or vapors. It resists weathering and it is thermally stable and flexible at all operating temperatures. It is an excellent moisture barrier.

- Notes: a. Dow-Corning, Midland, Michigan will supply a list of Silastic 50 gasket fabricators to all transformer manufacturers or users. They will also furnish technical data.
- b. Any user of Pyranol transformers, made by General Electric Company at Rome, Ga., will receive prompt and generous help for converting to the modern silicone or Viton gaskets by contacting the General Electric Company's Service Engineering Department at Rome, Ga.

See Appendix K: Seals, Properties and Procurements.

C. The Older Sealing Arrangements:

The older type gaskets consist of either cork or cork-nitrile rubber combinations or straight nitrile rubber.

1. **Cork-Nitrile Combinations:** Covers for the main tank, hand-holes, switch and terminal chambers, relief diaphragms etc. are held in place by studs welded to the flange or by bolts. The gaskets are cut with openings and placed over the bolts. Often Shellac (Westinghouse Style No. 1150419, or General Electric Company's Glyptal 1276) is used to cement the cork to the flanges.

The following is recommended for sealing with the cork — nitrile rubber combination:

Use Armstrong NC-757 cork-nitrile material or equivalent. The gasket can be cut from a single sheet or by scarfing strips of the material. A convenient method for joining strips is to make a Keystone Type joint. For this, Westinghouse, Sharon, Pa., offers their gasket cutter Style No. 328 B614 G01, (about \$15).

The joints should be cemented and the gasket also cemented to the flange, using one of the above cements. Excess cement should not be allowed to reach the interior of the transformer.

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After installation and bolting, the outside edge of the gasket should be coated thoroughly with epoxy cement to increase weather resistance.

This epoxy cement is a paste to which a curing catalyst is added immediately before use. Typical are:

- a. Epoxy Patch Kit #1-C
Hysol Corporation, Olean, N. Y.
- b. Scotchcast Resin #4
Minnesota Mining and Manufacturing Co.
St. Paul, Minnesota
- c. Adhesive A-1 and Activator Type B
Armstrong Products Company
Argonne Rd., Warsaw, Ind.
- d. Adhesive 9860-1, Synthetics Organic Company, Cleveland, Ohio, used with activator diethylene triamine (Carbide and Carbon Chem. Co.)

2. Straight Nitrile Rubber: When straight nitrile rubber was originally used, invariably the gasket was recessed in a groove. This was to prevent gasket flow and to protect the material against excessive compression. Although this type seal was not cemented, the nitrile rubber gasket is not reuseable.

Since grooves or stops have already been provided for the nitrile rubber seal, Silastic 50 can be easily substituted and is recommended. This conforms with modern practice.

X. PERIODIC FLUID INSPECTION AND WHAT CHECKPOINTS MEAN

On a regular schedule — at six, nine, or twelve month intervals — make a simple visual inspection of your askarel insulation and run a dielectric strength check.

A. Visual Inspection:

Askarel is a clear, faint-yellow liquid. After long-term use this color may gradually intensify to light brown. The fluid should remain clear and free from turbidity or cloudiness.

Any color change — such as to a green, red or blue cast — indicates extraction of impurities from the solid insulation. If a distinct foreign color pick-up is noted, check the complete range of electrical characteristics and notify the transformer maker. The electrical characteristics may be found to be unimpaired. Color change alone (except for black) is not a danger signal since the contamination is not likely to impair the dielectric strength.

B. Dielectric Strength:

If the dielectric strength has decreased significantly from the last inspection, or if it has gradually decreased below 26 KV range (at 25°C.) — RUN A CHECK FOR MOISTURE. Use ASTM D901, D877 (Karl Fischer Method).

The dielectric strength of askarel is the major indicator to the operating efficiency of your liquid insulation and of the askarel transformer itself. Besides the "visual" inspection tests, dielectric strength is the only test necessary to run on a routine basis. Well-sealed askarel transformers have service records of 25 to 30 years on the original askarel. New askarel has a minimum dielectric strength of 35 KV at 35°C., a maximum moisture content of 30 ppm.

REY 000933

XI. INSPECTION CHECK LIST

1. If askarel is clear, even though darkened to light brown; has no sediment or turbidity; has dielectric strength over 26 KV . . . give it the inspection "OK".
2. If askarel is clear; has foreign color of blue, green, red . . . it is "extracting color" from internal materials. This is not, of itself, an operating hazard when the dielectric strength stays over 26 KV and moisture remains low. However, this rare occurrence calls for checking into condition of the interior construction and consulting the transformer maker.
3. If askarel is clear; but dielectric strength drops to 22 or lower KV, and moisture rises over 80 ppm . . . the askarel is ready for simple "refining". If the moisture is near the saturation level (about 125 ppm), a thorough inspection should be made for water droplets in the transformer tank, and even for "globules" or water floating on the askarel surface. If found, the transformer manufacturer should be consulted for reconditioning both the transformer and the fluid.
4. If askarel is dark brown to black; if black particles of carbon are seen; and dielectric strength is low . . . the askarel has been broken down by arcing. It cannot be refined and should be discarded.

If any of these four simple inspection tests appear out of the ordinary, or the relationship between appearance and test values is abnormal — contact your transformer supplier for a complete analysis.

Whenever a sample is to be shipped to Monsanto, please follow the directions shown under: "SAMPLING ASKAREL".

XII. CONTAMINATION IN TRANSFORMERS

Unlike mineral oil which can oxidize, sludge and deteriorate — askarel breaks down in transformer use *only when strongly arced*.

Thus, while askarel does not decompose in normal use — it can be contaminated more readily than the relatively non-polar mineral oil.

For example the following Table VI shows how a small amount of synthetic rubber or a bit of varnished cloth markedly increases the power factor of the askarel. Please note, however, that *such minor contamination has no adverse effect on the dielectric strength*. As explained, moisture entrance through faulty seals seems the only contaminant in normal use that lowers the dielectric strength of transformer askarel.

Table VI EFFECT OF COMMON INSULATION MATERIALS ON POWER FACTOR AND DIELECTRIC STRENGTH (HEAT AGED 96 HOURS IN ASKAREL AT 100°C.)		
<u>Material Immersed</u>	<u>Askarel After Exposure</u>	
	<u>Power Factor, Percent at 60 cyc., 100°C.</u>	<u>Dielectric Strength 25°C.</u>
None (control).....	1.0	35 KV
Black varnished cloth.....	85.0	42
Copper.....	1.5	40
Pressboard.....	2.0	37
Manila paper.....	1.5	39
Phenol formaldehyde resins.....	1.6	41
Shellac.....	6.0	36
Iron.....	5.0	39
Synthetic rubber.....	70.0	39

Similarly, trace contaminants from commonly used construction materials can lower the volume - resistivity of askarel, without affecting its dielectric strength. Table VII shows this.

Table VII EFFECT OF COMMON INSULATION MATERIALS ON VOLUME RESISTIVITY OF ASKAREL	
<u>Sample</u>	<u>Volume Resistivity x 10⁹ ohm-cm (at 100°C., 500 Volts DC., 0.1" gap)</u>
1. New askarel before heat aging.....	2,000
2. New askarel after heat aging 96 hours at 100°C.....	1,900
3. After heat aging with 1 sq. inch specimens of:	
a. Phenolic resin tap changer material.....	1,200
b. Paper.....	750
c. Grade A press board (tan).....	500
d. Grade A press board (gray).....	500
e. Grade A press board, laminated strip.....	400
f. Cotton wrapping.....	300
g. Glyptal 1276 cement, cured 48 hrs. at 110°C.....	100

While trace contamination easily lowers volume resistivity from high levels, it is important as previously noted in Table V Case F, that heavy contamination (as when arced) does not lower the resistivity below the order of 10⁹ ohm-cm. at 100°C.

The different behavior of askarel vs. mineral oil in these respects can be summarized as follows:

High power factor and low volume resistivity in transformer mineral oils are commonly regarded as "danger signals" that the oil has deteriorated and broken down chemically.

This is NOT TRUE of askarel liquid insulation, unless the dielectric strength is low.

XIII. REFINING ASKAREL FOR RE-USE

A. Filtering Through Dry Blotter Paper to Remove Moisture and Extraneous Particles:

Most operators prefer portable refining apparatus, such as a plate press fitted with a dolly, (available from Sparkler, Mundelein, Ill., Westinghouse Maintenance and Repair Dept., Chicago, or General Electric Co., Pittsfield, Mass.); or the earthen cartridge filter type, (available from Industrial Filter Corp., Lebanon, Ind.). Filter paper liners for the plate press are available from Carl Schleicher and Schuell Company, Keane, New Hampshire and manufacturers of filter presses listed above.

The filter paper must be dried immediately before use. For best results, spread the paper for maximum surface exposure in a hot air circulating oven and heat it for 4 to 6 hours at 110°C.

If possible do not take the transformer out of service until ready to filter the fluid. This will keep the transformer coils relatively hot and dry. Processing the fluid should start immediately after de-energizing the unit.

Circulate the askarel hot (but not over 55-60°C.) through the filter fitted with the dry paper liners.

After filtration the dielectric strength of the askarel should be 35 K V minimum.

1. **Precautions:** Filtering should not be done when the relative humidity exceeds 75%.
2. Any flexible hoses and gaskets on the refining equipment should be lined with or made of materials that will not be softened by contact with askarel fluid. (Silicone or Teflon-lined, or flexible metal materials are suitable.)

Table VIII
GUIDE TO RATE OF DISSOLVED WATER REMOVAL
BY FILTERING ASKAREL THROUGH A PAPER PRESS

Passes Through Paper Press	Water in Askarel PPM
0	115
1	35
2	22
3	18
4	12
5	10
6	10

B. Earth Treatment for Maximum Improvement of Power Factor and Volume-Resistivity:

1. Procedure:

(The askarel liquid should be relatively dry prior to the following earth filtration.)

Use finely divided Attapulgus clay or Fuller's earth (dried and activated by heating for 12 hours at 300-350°F. immediately prior to use) as a coating on the filter paper surface. The amount of earth used should be 0.1 to 0.2 per cent by weight on the weight of the askarel to be treated. (Askarel weighs about 13 pounds per gallon).

To deposit the earth evenly, stir one-third of the earth with a small portion of askarel in a clean container. Pump the mixture through the filter and follow with two more one-third portions. Then circulate askarel taken from near the top of the transformer, pass it hot (not over 55-60°C.) through the earth coated filter and feed back through the bottom transformer outlet. Continue circulation until the fluid is clear and test shows that the electrical properties are fully restored.

2. Effect of Earth on Removal of Scavengers:

Only slight and insignificant loss (by selective absorption) of tetrphenyl and epoxides occurs when askarel is refined by treatment with 0.1 to 0.2 per cent by weight of earth. To remove significant amounts of the scavengers requires repetitious treatment with much larger amounts of earth.

3. Table IX — Approximate Relationship Between Power Factor, Volume-Resistivity and Dielectric Strength of Transformer Askarel:

Power Factor (60 cyc.)		Volume Resistivity x 10 ⁹ ohm-cm. (at 100°C., 500 Volts DC., 0.1" gap)	Dielectric Strength 25°C., 0.1" gap
100°C.	25°C.		
2%	0.05%	1500	35 KV
5%	0.1%	500	35
15%	0.7%	100	35
20-25%	2.0%	60-70	35
40-50%	—	25	35

If it is desired (although these factors are not generally considered important for askarel transformers), to keep the power factor as low as possible and the resistivity as high as possible, hang a container of anhydrous alumina or activated clay in the circulating system of the transformer.

XIV. CLEANING ARCED TRANSFORMERS

If a unit has arced so that the askarel is no longer fit for use, a thorough cleaning of the unit is necessary before refilling with new askarel insulation and returning it to service*. Follow this procedure:

REY 000937

- A. Drain out all dark, carbon-contaminated askarel. (Discard by dumping or burying where it will not contaminate a water supply.)
 - B. Carefully brush carbon deposits from internal parts and insulation, using a soft bristle brush making sure that insulation is not damaged.
 - C. Flush thoroughly using new askarel (*not* an oil, *not* a cleaning solvent).
 - D. Flush a second time with fresh askarel; drain; then fill to the proper level with new askarel.
 - E. Energize transformer to warm the fluid for 24 to 48 hours; then circulate the askarel through a filter, returning it to the unit filtered and ready for use.
- * This assumes that the cause of arcing has been established and corrections made. When severe arcing occurs, major repairs are usually necessary and the unit rebuilt. This procedure can be applied for flushing out repaired units.

XV. SAMPLING ASKAREL

Take a sample as close to the top of the liquid surface as possible. (Many large askarel transformers have a built-in sampling tube near the surface for convenient sampling). Then, to make sure that your SAMPLE truly represents your askarel insulation, take another sample from the bottom. If additional sampling tube connections are contrived on the valves for easier sampling, make the tubes of clean glass, stainless steel, aluminum or tin for rigid types; and silicone or Teflon tubing for flexible types.

Use NEW containers for the askarel sample. A new and thoroughly pre-dried small-mouth quart glass bottle fitted with a Bakelite screw cap fitted with an aluminum or tin bottle cap liner is recommended for "quick on-the-site testing." (If complete analysis is to be made, a 5-pint size sample is required).

Be sure that the new bottle does not stand open to collect dust or moisture. Rinse the sample bottle and cap lining two or three times with askarel from the transformer; then fill it. If the sample will be tested promptly, a clear glass bottle can be used. If sample is to be stored indefinitely, use an amber glass bottle or wrap clear glass with aluminum foil.

- A. Select a dry day. Do not sample insulation on a warm, moist day when humidity exceeds 75%, and . . .
- B. Make sure that the askarel is at least as warm as the surrounding air. (Cold liquids can condense moisture from humid air.)
- C. When sampling askarel from transformers, it is best to take the sample when the unit is warm and operating at average or maximum load. Especially as a check on moisture (as reflected by a dielectric strength test), sampling the warm askarel more truly represents its condition during operation.

Experience shows that water will migrate from a transformer's solid insulation to the askarel liquid and vice versa, depending on temperature. Therefore, when the transformer is hot, the moisture is most likely to be found in the liquid. This accounts largely for periodic variations in dielectric strength. For example: a relatively high dielectric strength may be found during winter months and a relatively low dielectric strength during the summer months on samples taken from the same unit.

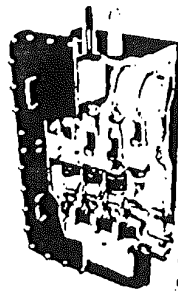
REY 000939

SECTION B

ASKAREL FILLED SWITCHES AND TERMINAL CHAMBERS

I. INTRODUCTION:

High voltage leads are usually connected to askarel or mineral oil-filled network transformers and power centers through terminal chambers and switches. In some cases terminal chambers are not used, and the high voltage leads are connected directly to the switch terminals. They may be filled with either askarel or mineral oil. Switches are usually rotary or drum type fitted with a revolving block and porcelain unit as the principal element arranged for three-phase service. (A cutaway view of a typical terminal chamber-switch combination is shown for reference.)



Askarel transformers with attached switches have been in use for about 30 years. When they were first introduced, the availability of insulating and gasketing materials was rather limited and even the best materials at the time had no service history. As a result, inadequate gasketing materials such as cork, nitrile rubber, and nitrile rubber-and-cork particles were used. While satisfactory for a limited period of time, these materials cannot be depended on for the expected long life of the equipment.

The terminal chamber is usually above or below the switch compartment and separated by a steel wall through which the bushings are inserted. When bushings are properly selected and correctly installed, there is no leakage from one compartment to the other. With poor bushing seals, and the terminal chamber above the switch, potting compounds or cable oil can seep into the askarel. When the terminal chamber is below the switch, askarel can drain into the terminal chamber.

II. SOURCES OF CONTAMINATION

There are three possible sources of contamination for askarel in switches and terminal chambers; they rank in this order of frequency: (1) water entering through poor gaskets; (2) decomposition products from arcing when switch is used to break magnetizing current; (3) entrance of pothead or cable compounds through leaky bushing seals.

Unlike an askarel transformer where the amount of contaminant is likely to be very small (probably only trace amounts) in relation to the volume of askarel fluid — in switches or terminal chambers with faulty seals, the amount of contamination can be relatively large.

Experience has shown that, based on the number of installed askarel-switch units, the percentage of failures is extremely small. When investigated, it has been found that most failures originate in the switch chamber. Water is the chief source of contamination. However, heavy contamination of askarel with petrolatum and asphalt material, due to leakage, have caused a few failures.

Petrolatum is used frequently for filling terminal chambers. When either cable oil or petrolatum seeps into askarel, no great harm results. The fire resistance will be somewhat decreased and power factor of the askarel will increase with an accompanying drop in resistivity. While highly undesirable, it is doubtful that failure of the unit results. Where asphaltic compounds are used in place of petrolatum, the danger is increased somewhat because asphaltic contamination may cause excessively high dielectric losses in the askarel.

When the terminal chamber is below the switch chamber, the potting compound can be contaminated by askarel if the bushing seals are leaky. This is undesirable because the askarel will increase the power factor and conductivity of the potting compound or cable oil and develop heat from dielectric loss. If this mixture is drawn into the cable insulation, a cable failure is likely. This again emphasizes the importance of tight bushing assemblies.

III. SEALING SWITCHES AND TERMINAL CHAMBERS

Proper bushing construction, use of Silastic seals and welding wherever possible is highly desirable (as covered in Section A). Where an elastomeric seal is to be used in contact with both askarel and petroleum oil, DuPont's Viton is suggested.

For new equipment the user should specify these modern sealing arrangements to keep out contaminants and minimize maintenance.

IV. MAINTENANCE FOR ASKAREL FILLED SWITCHES

- A.** Switches used for grounding after power source has been de-energized will not undergo arcing.
- B.** Switches interrupting magnetizing current will be subject to arcing; the amount of decomposition will depend on power interrupted, time and frequency of operation. As a general rule, the liquid should be checked after 5 to 10 operations.

1. On newly installed switches, check the askarel at 3, 6 and 12 month intervals; if found satisfactory, check once annually thereafter. With proper attention to the gasketing of covers and bushings, experience will probably indicate that less frequent inspection is warranted.
2. Check askarel for:
 - a. Dielectric strength (ASTM D877): It should be 26 KV minimum. If dielectric strength is low, confirm presence of water by Karl Fischer method ASTM D-1533. Filter to remove moisture. Dielectric strength should then be 30 KV minimum.
 - b. Presence of carbon from arcing: Fluid should be relatively free of carbon. If badly arced and very black, replace fluid. If only minute amounts of carbon are present, filtration is recommended. Check power factor of liquid (should not be over 5% at 25°C. and 60 cycles). Flush out switch chamber with several gallons of fresh askarel before refilling.
3. If there is discoloration, high power factor, detectable change in specific gravity or refractive index, or if fluid flashes below 250°F., there is a possibility of seepage of potting compound into the switch compartment. In this case, correct any leaky bushing seals with proper replacements and fill with new askarel.
4. If terminal chamber is below switch, check potting compound for presence of askarel (can usually be detected by odor or by an increase in specific gravity). If askarel is present, correct any leaky bushing seals with proper replacements, and renew compounds.
5. Examine cover gaskets visually. Deterioration can be detected by swelling and cracking of the exposed edge. In cases of severe deterioration, liquid seepage is usually present.
6. Check for leakage at packing gland of switching shaft. If leaking, repack with a Silastic ring type gasket.

SECTION C
ANALYTICAL SERVICES ON TRANSFORMER ASKAREL AVAILABLE
FROM MONSANTO

Transformer users not wishing to make their own fluid analyses can obtain the service from Monsanto. Simply contact Monsanto and specify what analyses are wanted. You will be sent the proper-sized sample container filled with fresh askarel. When you receive this, empty it and carefully take your sample (following the procedure for sampling in this guide). Send the container to Monsanto's laboratory. Charges listed include sample container, shipping, handling and laboratory costs.

Types of Analyses Available

Analysis 1)

ROUTINE MAINTENANCE CHECK

Total Charge: \$20.00

To determine the general condition of the fluid and find whether further analysis is necessary. (one-quart sample required)

Properties Tested
Color and Condition
Dielectric Strength
Moisture

You will be notified of the results of this test. If further testing is indicated, and you want a complete analysis, you will be sent a five-pint sample container. This sample will be used for the following series of tests:

Analysis 2)

COMPLETE ANALYSIS

Total Charge: \$50.00

(a) To determine the extent of fluid contamination, (b) earth refinement to determine what degree of restoration of electrical and insulating properties is possible, (c) check test to see how the fluid responded to earth treatment.

a) **Complete Analysis:** to determine the extent of contamination

Properties Tested
Color and Condition
Specific Gravity
Refractive Index
Water
Free Chlorides
Acidity
Dielectric Strength
Power Factor, Dielectric Constant, and Resistivity

REY 000943

b) Earth Refinement Response:

Consists of treatment for 2.5 hours at 50-60°C. with 0.1 to 0.2 percent by weight of properly conditioned Attapulgus clay and then filtration through dry filter paper.

c) Analysis After Laboratory Earth Refinement:

Properties Tested

Refractive Index

Water

Free Chlorides

Acidity

Dielectric Strength

Power Factor, Dielectric Constant, and Resistivity

You will be notified of the results of this test series on your sample. Then after refining your entire transformer fluid fill you can check on the results by requesting the following analysis:

Analysis 3)

ANALYSIS AFTER EARTH REFINEMENT

Total Charge: \$30.00 (This charge will not apply when analyses 1 and 2 have already been made.)

To determine whether the entire lot of the askarel fill responded to the same extent as the laboratory sample. (five-pint sample required)

Properties Tested

Color and Condition

Refractive Index

Water

Free Chlorides

Acidity

Dielectric Strength

Power Factor, Dielectric Constant, and Resistivity

To arrange for the tests described above write to the following address:

Paul G. Benignus
Monsanto Chemical Company
800 North Lindbergh Blvd.
St. Louis 66, Missouri

Samples to be tested should be clearly marked for identification and sent directly to:

Monsanto Chemical Company
W. G. Krummrich Laboratory
Monsanto, Illinois
Attention: R. Kuster

APPENDIX

APPENDIX A — Askarel Stability and Composition of Arc Formed Gas:

Askarel insulation is one of the most inert, chemically-stable heat resistant, non-corrosive liquids known. It will not break down, oxidize or sludge when exposed to air and high temperatures, 150°C. or even somewhat higher. Arcing, however, will break down the compound to liberate some hydrogen chloride and small amounts of carbon.

APPROXIMATE COMPOSITION ARC FORMED GAS FROM TRANSFORMER ASKAREL

Gas	Amount
carbon monoxide.....	0.3 per cent
carbon dioxide.....	0.3
oxygen.....	0.6
inert gases.....	1.5
hydrogen chloride.....	97.3

(note the absence of phosgene)

This arc-formed gas is non-flammable and non-combustible. These requirements must be met in accordance with the Underwriters' Laboratory for permission to use the term askarel.

Mineral oil evolves combustible hydrogen and hydrocarbon gases.

For all practical purposes, the amount of gas liberated from mineral oil or askarel under a given set of conditions is about 100 cubic centimeters per kilowatt-second.

APPENDIX B

SOLUBILITY OF GAS IN TRANSFORMER ASKAREL				
	Percent of Gas By Volume Corrected to:			
	25°C. 760 mm		0°C. 760 mm	
	25°C.	100°C.	25°C.	100°C.
Carbon dioxide.....	71%	47%	—	—
Air.....	5.7	4.9	5.8	5.0
Nitrogen.....	6.0	4.8	5.5	4.4
Hydrogen chloride ¹	37.8	50.9	—	—
1) In absence of scavenger				

APPENDIX C

APPROXIMATE VAPOR PRESSURE vs. TEMPERATURE FOR TRANSFORMER ASKAREL		
Temperature °C	Inerteen PPO, 7336-9	Transformer Pyranol A13B3B
40	1 mm Hg.	0.9 mm Hg.
60	5	3.5
80	9	8.3
100	30	18
120	60	32
140	90	53

APPENDIX D

EFFECT OF TEMPERATURE ON DIELECTRIC STRENGTH OF ASKAREL	
Temperature °C.	Dielectric Strength
-60	67 KV
-40	63
-20	57
0	55
20	50
40	50
60	48
80	45

APPENDIX E

COMPARISON OF THE APPROXIMATE VISCOSITY IN SAYBOLT UNIVERSAL SECONDS OF TRANSFORMER ASKARELS AND MINERAL OIL			
Temp. °C.	Transformer Pyranol A13B3B	10-C Mineral Oil	Inerteen PPO, 7336-9
-20	1,000	1,000	2,800
0	100	150	195
20	70	85	85
40	45	49	50
60	39	40	40
80	34	34	36
100	30	30	33

APPENDIX F

THE DENSITY OF INERTEEN PPO 7336-9 AND TRANSFORMER PYRANOL A13B3B Approx. Density gm/cc.		
Temperature °C.	Inerteen PPO, 7336-9	Transformer Pyranol A13B3B
0	1.574	1.577
20	1.552	1.555
40	1.529	1.532
60	1.507	1.510
80	1.485	1.488

APPENDIX G

The thermal conductivity values of transformer Pyranol A13B3B at 27°C. and 58°C. are 26.2 and 25.8×10^{-5} calories centimeters⁻¹, degrees centigrade⁻¹, second⁻¹, respectively. Or, approximately 0.06 BTU per (hr.) (sq. ft.) (°F.) per foot. This same approximation applies to Inerteen PPO (7336-9).

APPENDIX H

Heat Capacity

Over the temperature range of 25° to 125°C. the specific heat of transformer askarel is close to 0.30 calories per gram per degree.

APPENDIX I

Coefficient of Expansion

The average coefficient of expansion of transformer askarel over the temperature range 20 to 100°C. is 0.007 cc/cc/°C. One gallon would increase to 1.056 gallons on heating from 20 to 100°C.

APPENDIX J

Fire-Resistance

To use the generic name "askarel," the fluids must be approved by the Underwriters' Laboratories as possessing adequate fire-resistance and freedom from forming explosive gases when arced. These liquids do not have a burn point (ASTM D92-33) (Cleveland open cup method) up to about 205°C., at which temperatures they begin to boil. The significance of this is that they do not burn or support combustion under conditions encountered in transformer operation. Thus the danger of secondary explosion (or fire) is eliminated.

REY 000947

APPENDIX K

Seals, Properties and Procurement

Dow Corning Corporation, Midland, Michigan with District's at Atlanta, Boston, Chicago, Cleveland, Dallas, Los Angeles, New York City, Washington, D. C. and Toronto has available Bulletin 09-019, August 1962 entitled "Silastic Design Data". This lists the gasket fabricators throughout the country from whom the "Silastic 50" gasketing can be purchased in sheet, extrusions or molded shapes.

Generally Silastic 50 sheet goods are stocked by local die cutters, hence, could be generally purchased locally. Usually, small quantities of gaskets are die cut. If larger quantities are needed, tools are made of the same type used to cut other elastomers.

Where the gasket is extruded for fitting into a machined groove or between gasket stops, Dow-Corning advises use of a scarved joint. This joint is then cemented using Dow Corning's Silastic 140 (clear) or their RTV 731 (white) materials, which air cure.

Dow Corning points out that the local "rubber" fabricators purchase the Silastic 50 in billet form. This is worked on a roll mill in preparation for sheeting or extrusion. Then to obtain the desired physical properties the fabricator must oven cure the Silastic 50 for 24 hours at 480°F.

SPECIFICATIONS*

Color	White
Specific Gravity at 77°F.	1.20 ± 0.02
ASTM D676 — Hardness, Shore A. Scale	45 to 60
ASTM D412 — Tensile Strength, psi, min.	800
ASTM D412 — Elongation, percent, min.	250
ASTM D395 — Compression Set after 22 hours at 300°F., percent, max.	30

- * All physical properties measured on 0.075 inch thick samples molded 5 minutes at 240°F., and oven cured 24 hours at 480°F.

General Electric Company, Redmond Circle, Rome, Ga., uses silicone or DuPont's Viton wherever it is not possible or desirable to weld. For some small seals, where good matching surfaces are provided, Flexitallic stainless steel rings are used.

By contacting the Engineering Services Department of General Electric Company, Redmond Circle, Rome, Ga., users of Pyranol transformers made prior to development of these modern seals will obtain prompt assistance for conversion.

Users of askarel transformers made by other manufacturers should contact the original transformer manufacturer, or Monsanto for assistance in converting to these modern seals.

REY 000948

NOTES

REY 000949



MONSANTO
FUNCTIONAL FLUIDS DEPT.

800 N. LINDBERGH BLVD.
ST. LOUIS, MISSOURI 63166

The information herein regarding obtaining optimum results from askarel fluids in your transformer has been accumulated by Monsanto for over 30 years from the experience of makers and users of askarel transformers and it is believed will be helpful.

Nothing herein shall be construed as applying to other than askarel insulation. Data and maintenance suggestions herein do not apply to the other components of the transformer. All operating and maintenance suggestions recommended by the manufacturer of the transformer should also be carefully followed.

Because these maintenance directions apply only to the askarel insulation, Monsanto disclaims any liability for damage to property or injury to persons arising from transformer operation.

REY 000950

Litho in U. S. A.

Hydraulic Fluids

Monsanto

ORGANIC CHEMICALS DIVISION

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 894-1000

February 9, 1970

Dear Sir:

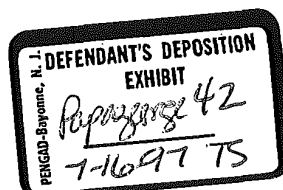
Recently several newspaper and magazine articles have been published indicating that Polychlorinated Biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million and parts per billion categories.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. Products which are sold by Monsanto under the trade names of Aroclor® 1254 and 1260 do contain chlorinated biphenyls. In addition to Aroclor® 1254 and 1260, Monsanto sells certain functional fluids containing Aroclor® 1254. These include Pydraul® 625, Pydraul® AC, Pydraul® AC - Winter Grade, Pydraul® 540, Therminol® FR-3 and certain dielectric formulations. Several other companies around the world also produce products containing chlorinated biphenyls.

As your supplier of Aroclor® 1254 and 1260 and formulated products containing 1254, we wish to alert you to the potential problem of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts.

1. Products such as Pydraul® 90, 135, 230, 312, A-200, F-9, 150 and 60, Turbinol® 153 and Therminol® FR-1 and FR-2 are not formulated with Aroclor® 1254 or 1260.
2. PCBs with a chlorine content of less than 54% have not been found in the environment and appear to present no potential problem to the environment.



MONS 090210

We have developed, and are now testing, new formulations to replace the Aroclor® 1254 and 1260 components in our Pydraul® products. The new products appear to be equal in performance and to have similar physical properties.

We feel that all possible care should be taken in the application, processing and effluent disposal of these products to prevent them becoming environmental contaminants. Of interest to you may be an article in Chemical Week, October 29, 1969 regarding water pollution standards set by each state in the Union. It is attached. This article reflects that good manufacturing practice in the future may require that no products used by any company should find their way into waterways..

Sincerely yours,

Donald A. Olson

Donald A. Olson
Director of Sales
Functional Fluids Group

nlc
Attachment

MONS 090211

W. B. PAPAGEORGE - ST. LOUIS

APRIL 13, 1970

J. MASON
P. S. PARK

AROCLOR LABELING

H. S. BERGEN
M. W. FARRAR - SECOND STREET
E. V. JOHN
C. PATON
W. R. RICHARD
J. R. SAVAGE
J. E. SPRINGGATE
E. P. WHEELER
D. A. OLSON

During our April 3rd meeting, the subject of modifying the labels on Aroclor packages was reviewed and Phocian Park offered to work on the appropriate wording.

He suggests the following paragraph be added to the existing wording:

"This product contains polychlorinated biphenyls, which some studies have shown may be an environmental contaminant. Care should be taken to prevent any loss into the environment through spills, leakage, disposal, evaporation or otherwise."

This additional wording is intended for packages containing Aroclors 1242, 1248, 1254, 1260, 1262, 1268, 4465 and Montars 1, 2, 3, 4 and 7.

Attached is a copy of a typical label. The proposed wording would appear in the space below the present printing.

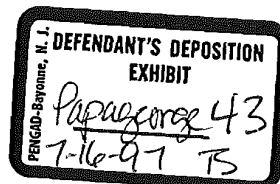
We are anxious to make this change quickly. May I have your comments?

W. B. PAPAGEORGE

ms

Attachment

MONS 098183



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