

SUPERIOR COURT OF NEW JERSEY
LAW DIVISION
GLOUCESTER COUNTY

NVF COMPANY,	)	
	)	
Plaintiff,	)	Docket No.
Vs.	)	GLD L-001594-91
	)	
AMERICAN CASUALTY COMPANY OF	)	Civil Action
READING, PENNSYLVANIA, ET AL.,	)	
	)	
Defendants.	)	

CONTINUED DEPOSITION OF WILLIAM B. PAPAGEORGE
Taken on Behalf of
Lumbermens Mutual Casualty Company

Day Two
August 27, 1997

COPY

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IN THE SUPERIOR COURT OF NEW JERSEY
LAW DIVISION
GLOUCESTER COUNTY

NVF COMPANY,)
)
Plaintiff,)
vs.)
) Docket No.
AMERICAN CASUALTY COMPANY) GLD L-001594-91
OF READING, PENNSYLVANIA,)
ET AL.)
)
Defendants.)

CONTINUED DEPOSITION OF WILLIAM B.

PAPAGEORGE, produced, sworn and examined on the
27th day of August, 1997, between the hours of
eight o'clock in the forenoon and six o'clock in
the afternoon of that day, at the offices of
Taylor and Associates, 7494 Ethel, St. Louis,
Missouri, before Nancy A. Kuncaitis, a
Registered Professional Reporter and Notary
Public within and for the State of Missouri in
the cause now pending in the Superior Court of
New Jersey, Law Division, Gloucester County,
wherein NVF Company is the Plaintiff, and
American Casualty Company of Reading
Pennsylvania, et al. are the Defendants.

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1 IT IS HEREBY STIPULATED AND AGREED by and
2 between Counsel for the Plaintiff and Counsel
3 for the Defendant that this deposition may be
4 taken by Nancy A. Kuncaitis, Notary Public and
5 Registered Professional Reporter, thereafter
6 transcribed into typewriting, with the signature
7 of the witness being expressly reserved.

8
9 WILLIAM B. PAPAGEORGE,
10 of lawful age, being produced, sworn and
11 examined on behalf of Lumbermens Mutual Casualty
12 Company testified as follows:

13
14 EXAMINATION

15 QUESTIONS BY MR. WARNING:

16 Q. Good morning, Mr. Papageorge.

17 A. Good morning.

18 Q. As you know, on July 30, 1997, we were taking
19 your deposition in this case and today we are
20 continuing and ending that deposition. And do
21 you recall all the preliminary instructions that
22 I gave you on July 30?

23 A. I do.

24 Q. And do we agree those will apply today as well?

25 A. Certainly.

1 Q. Mr. Papageorge, do you remember on July 30, when
2 I had shown you some copies of labels that
3 Monsanto used for Aroclor products?

4 A. I do.

5 Q. Do you know if Monsanto has any originals of any
6 of those labels?

7 A. I personally don't know at this point in time.

8 MR. WARNING: Off the record a
9 moment.

10 (Discussion off the record)

11 MR. WARNING: Back on the record.

12 Q. Mr. Papageorge, during your employment at
13 Monsanto, were you ever aware of any heat
14 transfer systems which used Aroclors leaking?

15 MR. KLINE: Objection, are you asking
16 him at the Monsanto facilities or nationwide?

17 MR. WARNING: Good point.

18 Q. Any system outside of Monsanto?

19 A. The period of time is throughout my employment
20 with Monsanto?

21 Q. Correct.

22 A. Yes.

23 Q. Could you explain your knowledge of any leaks
24 from heat transfer systems that used Aroclors?

25 A. I don't know what you mean by knowledge. You

1 mean my awareness of a leak or what caused it
2 and where in the system it happened? It can get
3 pretty complex.

4 Q. Okay. How did you become aware that some heat
5 transfer systems using Aroclors would leak?

6 A. By personal observation, my involvement with the
7 maintenance of such systems, and my being
8 informed from customers that were using the
9 fluids that Monsanto supplied. That about
10 covers it.

11 Q. Do you know where within those systems leaks
12 would occur?

13 MR. KLINE: I'm going to object as
14 overbroad, but you can answer.

15 A. It could happen virtually anywhere in the
16 system. Some parts of the systems are more
17 vulnerable to the presence of leakage, but it
18 could happen anywhere.

19 Q. Which systems were more vulnerable to leaking?

20 A. When you say systems, are you describing the
21 entire heat transfer system or portions within
22 the systems?

23 Q. When I'm referring to systems, I'm referring to
24 the entire heat transfer system.

25 A. Generally those that operated at the higher

1 temperature, and those that were operated at
2 higher pressures.

3 Q. When you say temperature and pressures what are
4 you referring to?

5 A. I'll try to remember. And I'm sure these are
6 not totally accurate. I would suggest that
7 temperatures above 400 degrees Fahrenheit and
8 pressures exceeding 200 pounds per square inch.

9 Q. Was this knowledge that Monsanto shared with
10 parties that used the heat transfer systems?

11 A. When you say -- do you mean did Monsanto tell
12 customers under these conditions you might have
13 leaks, is that what you mean by that?

14 Q. Correct.

15 A. Of course I can't speak for the individuals that
16 were dealing directly with the customer but in
17 assisting the customer in selecting the portions
18 of the system that might be affected such as the
19 packing around a pump or the gasket between two
20 connecting flanges, pressures and temperatures
21 are definitely a part of that consideration in
22 selecting do you use an asbestos gasket or a
23 Teflon gasket and so on.

24 Q. Do you know if there was anything that users of
25 the heat transfer systems could do to avoid

1 leaks?

2 MR. DAVIDSON: Let me interpose an
3 objection. Monsanto is not a manufacturer of
4 heat transfer systems and not a manufacturer of
5 all types of heat transfer fluids. There are
6 hundreds, I suppose. Your notice called for
7 questions with regard to use of Aroclors in heat
8 transfer systems. Monsanto wasn't in the
9 business of advising people about heat transfer
10 systems generally or how they worked or how they
11 should work or any of that sort of stuff, so we
12 need to get back more to the focus of what your
13 suit is about.

14 MR. WARNING: I understand your
15 concern. I'm almost done with this area.

16 MR. DAVIDSON: Just that water and
17 oil, petroleum oils, Aroclors and a whole lot of
18 different things could be heat transfer media.

19 MR. WARNING: Right, and my questions
20 were directed, and I should have been more
21 clear, directed to heat transfer systems using
22 Aroclors is what I'm referring to.

23 Q. Mr. Papageorge, do you know if there were any
24 benefits to using Aroclors rather than other
25 fluids that could be used as heat transfer

1 fluid?

2 A. Well --

3 MR. KLINE: Objection, no
4 foundation.

5 A. The benefits that could be described would be
6 based on what it's being compared to. I have in
7 mind such things as fire resistance. Water is
8 fire resistant also, but the benefits of Aroclor
9 is that they can reach higher temperature
10 without having to resort to high pressure steam,
11 which usually requires a licensed operator.
12 Then one might talk about the benefits of just
13 clear lubricity of this Aroclor as compared to
14 some other fluids, whether it be water or
15 petroleum oil or glycol and so on. So I don't
16 know that I answered your question, but it
17 depends what you're comparing it to.

18 (Product brochure
19 marked as Exhibit No. 17
20 for identification.)

21 Q. Mr. Papageorge, you've just been handed a
22 document that's been identified by the court
23 reporter as Papageorge Exhibit No. 17. Would
24 you take a moment to look at that, please?

25 A. I have scanned the document.

1 Q. Thank you. For the record, this begins with
2 Bates number NVF 68. Have you seen this
3 document before?

4 A. Yes, I have.

5 Q. Could you tell us what it is, please?

6 A. This is a copy of a product brochure developed
7 by Monsanto to describe the properties of
8 plasticizers sold under the trademark Aroclor,
9 in, I would suggest, about 1971.

10 Q. You just said about 1971. Would that be the
11 date that this was prepared to the best of your
12 knowledge?

13 A. To the best of my knowledge, yes.

14 Q. Mr. Papageorge, was this a document that was
15 prepared in the ordinary course of Monsanto's
16 business?

17 A. Yes.

18 Q. Was either this document or a copy of this
19 document kept within Monsanto's files?

20 A. Yes.

21 Q. That's all I have with that. Thank you.

22 (Group of documents
23 marked as Exhibit No. 18
24 for identification.)

25 Q. Mr. Papageorge, you've just been handed several

1 documents that have been grouped together as
2 Papageorge Exhibit No. 18. These are documents
3 with Bates numbers NVF 114, 115, 116 and 117.
4 If you would take a moment to look at those,
5 please?

6 A. I have looked at the exhibit.

7 Q. Have you seen these documents before, Mr.
8 Papageorge?

9 A. I have.

10 Q. Could you tell us what they are, please?

11 A. The first three, NVF 114, 115, 116 are copies of
12 what Monsanto referred to as call reports.
13 These are reports prepared by marketing
14 representatives describing visits with customers
15 and what was discussed. The document marked NVF
16 117 is a memorandum, a Monsanto memorandum in
17 which a field marketing representative informed
18 a marketing representative in St. Louis of an
19 order placed by NVF.

20 Q. Do you know if these documents were produced in
21 the ordinary course of Monsanto's business?

22 A. Yes, they were.

23 MR. LOHMAR: Produced or prepared?

24 MR. WARNING: Prepared.

25 A. Yes.

1 Q. And would either the original or a copy of these
2 documents have been kept in Monsanto's files?

3 A. Yes.

4 Q. If you would look at Page 114, please?

5 A. I have it.

6 Q. Do you see about halfway down that document
7 where it says to CP Farley?

8 A. I see that.

9 Q. Do you know who CP Farley is?

10 A. Mr. Farley was a marketing representative
11 located in St. Louis who assisted the field
12 people in responding to any inquiries made by
13 customers which the field individual felt he
14 needed further information.

15 Q. And do you see next to CP Farley there is WS
16 Clark?

17 A. I see that.

18 Q. Do you know who WS Clark is?

19 A. Mr. Clark at that time, as best I remember, was
20 Mr. Farley's immediate supervisor.

21 Q. Do you see above that to the right there, a box
22 labeled "salesman"?

23 A. Yes.

24 Q. Do you see John M. Van Gelder?

25 A. I do.

1 Q. Do you know who that is?

2 A. He is the marketing representative operating out
3 in the field making calls on customers within a
4 given geographic area.

5 Q. Would you look at Page 115 please, Mr.
6 Papageorge?

7 A. I have it.

8 Q. Do you see about halfway down that document
9 where it says to JH Orem?

10 A. I see that.

11 Q. Do you know who JH Orem is?

12 A. Yes.

13 Q. Could you tell us who he is, please, he or she?

14 A. Mr. Orem, as best I remember, Mr. Orem replaced
15 Mr. Farley in the St. Louis office.

16 Q. Mr. Papageorge, do you know why the call reports
17 which comprise documents 114, 115 and 116 were
18 generated at Monsanto?

19 A. Of course I can't put myself in the position
20 that the field salesmen were in. It varied, the
21 use of the call report varied with the field
22 marketing representative's perception of the
23 importance of the item discussed, his ability to
24 get to a telephone, and his need to talk to more
25 than one person at a time and so I really can't

1 tell you why these particular call reports were
2 prepared.

3 Q. Do you know if it was normal practice of
4 Monsanto employees to prepare a call report?

5 A. It wasn't only normal, it was a quite frequent
6 practice.

7 Q. Mr. Papageorge, would you look at Page 117,
8 please, in that exhibit?

9 A. I have it.

10 Q. Do you see near the bottom of the print on that
11 page a name which is Fred G. Sutton?

12 A. Yes.

13 Q. Do you know who Fred G. Sutton is?

14 A. Yes, I was trying to recall the exact title. He
15 was, as best I remember, a district manager to
16 whom the field salesmen reported in that area.

17 Q. That's all I have with that exhibit. Thank
18 you.

19 (Group of documents
20 marked as Exhibit No. 19
21 for identification.)

22 Q. Mr. Papageorge, you've just been handed several
23 documents that have been grouped together as
24 Papageorge Exhibit No. 19. These documents each
25 begin with the following Bates numbers: NVF

1 3625, 3635, 3637, 3641, and 3699. If you would
2 take a moment to look at those, please.

3 MR. KLINE: Brett, do you have an
4 extra copy?

5 MR. WARNING: Sorry, I don't.

6 MR. KLINE: You had given an extra
7 copy -- not for this one.

8 MR. WARNING: Unfortunately, there
9 are a couple that I don't have an extra copy.

10 MR. KLINE: Mr. Davidson is taking a
11 look through his file to see; otherwise, I'll
12 have to sit next to you.

13 MR. LOHMAR: I'll switch.

14 MR. WARNING: Off the record.

15 (Discussion off the record)

16 MR. WARNING: Back on.

17 Q. Mr. Papageorge, have you had the opportunity to
18 take a look?

19 A. Yes, I have reviewed them.

20 Q. If you would look at the document beginning with
21 Bates number 3625, please?

22 A. I have it.

23 Q. Have you seen this before, Mr. Papageorge?

24 A. I have.

25 Q. Can you tell us what it is, please?

1 A. This is a copy of a material safety data sheet
2 prepared on the Occupational Safety and Health
3 Administration's form by Monsanto for a product
4 entitled reclaimed Aroclor.

5 Q. Do you know what this was used for?

6 A. This was used to share with anyone that was
7 involved with Aroclors whether it be Monsanto
8 employees, transportation people, truckers and
9 railroads and the like and customers as well as
10 regulatory agencies and the general public that
11 might be interested.

12 Q. Documents which begin with Bates numbers 3635,
13 3637 and 3641, are those also similar material
14 safety data sheets?

15 A. They are similar and they cover a little
16 different version of Aroclor products.

17 Q. Have you seen those three documents before, Mr.
18 Papageorge?

19 A. Yes, I have.

20 Q. And those three documents along with document
21 3625, were they prepared by Monsanto in its
22 ordinary course of business?

23 A. They were.

24 Q. And were they or copies of them kept within
25 Monsanto's files?

1 A. Yes.

2 Q. Would you look at the document that begins with
3 Bates number 3699, please?

4 A. I have it.

5 Q. Have you seen this document before, Mr.
6 Papageorge?

7 A. I have.

8 Q. Could you tell us what it is, please?

9 A. This is a copy of a letter, Monsanto letterhead
10 prepared by Elmer P. Wheeler in Monsanto's
11 corporate medical department, and the subject it
12 covers is the latest available information
13 relating to the presence of PCBs in the
14 environment.

15 Q. Do you know if this document was prepared by
16 Monsanto in its ordinary course of business?

17 A. It was.

18 Q. Do you know if this document or a copy of this
19 document was kept in Monsanto's files?

20 A. It was.

21 Q. Mr. Papageorge, do you know who this letter was
22 sent to?

23 A. It was sent to the customers that according to
24 Monsanto's records represented the biggest
25 users, which were primarily the manufacturers of

1 electrical equipment.

2 Q. That's all I have with that exhibit. Thank
3 you.

4 (Letter dated 8/14/70
5 marked as Exhibit No. 20
6 for identification.)

7 Q. Mr. Papageorge, you've just been handed a
8 document which has been identified as Papageorge
9 Exhibit No. 20. Would you take a moment to look
10 at that document, please? This document
11 contains Bates number NVF 63.

12 A. I have read the document.

13 Q. Have you seen this document before, Mr.
14 Papageorge?

15 A. Yes, I have.

16 Q. Could you tell us what it is, please?

17 A. This is a copy of a Monsanto memorandum authored
18 by Paul W. Gann, G-A-N-N, and it's addressed to
19 the file and it lists recipients of a warning
20 letter mailed on August 14, 1970.

21 Q. Mr. Papageorge, do you know if this document was
22 prepared in the ordinary course of Monsanto's
23 business?

24 A. It was.

25 Q. Do you know if the original or a copy of the

1 document was kept within Monsanto's files?

2 A. It was.

3 Q. Mr. Papageorge, do you know why this document
4 was created?

5 A. I really don't know what Mr. Gann intended. I
6 can only speculate and I don't want to do that.

7 Q. We don't want you to speculate. That's all I
8 have with that exhibit.

9 (Safe handling information
10 marked as Exhibit No. 21
11 for identification.)

12 Q. Mr. Papageorge, you've been handed an exhibit
13 identified as Papageorge Exhibit No. 21 which
14 contains two documents with Bates numbers NVF
15 3585 and 3595. If you would take a moment to
16 look at that, please?

17 A. I have scanned the two documents.

18 Q. Mr. Papageorge, have you seen those two
19 documents before?

20 A. Yes, I have.

21 Q. Could you tell us what they are, please?

22 A. These are copies of toxicity and safe handling
23 information for Monsanto's product Pydraul F-9
24 prepared by R. Emmett Kelly, Monsanto's
25 corporate medical director.

1 Q. Do you know if these documents were prepared in
2 the ordinary course of Monsanto's business?

3 A. Yes, they were.

4 Q. Were these documents or copies of them kept in
5 Monsanto's files?

6 A. Yes.

7 Q. Mr. Papageorge, do you know if these documents
8 were distributed to anyone outside of Monsanto?

9 A. Yes, they were.

10 Q. Do you know who they would have been distributed
11 to?

12 A. This would have been customers of Monsanto that
13 had purchased Pydraul F-9 for use at their
14 facilities. It was also given to potential
15 customers, entities that exhibited an interest
16 in this type of material and were considering
17 using it in their equipment.

18 Q. On document 3585 do you see near the bottom left
19 corner one slash seven slash '64?

20 A. I do.

21 Q. Do you know if that's the date of that document?

22 A. That's the date of the issuance of the document.

23 Q. On 3595 do you see near the bottom left-hand
24 corner May 3, 1968?

25 A. I do.

1 Q. Would that be the date that document was
2 prepared?

3 A. Yes.

4 Q. When you said these were given to customers of
5 Pydraul and potential customers, how did
6 Monsanto determine which customers would receive
7 these if you know?

8 A. Well, the records would indicate who had
9 purchased Pydraul F-9. They would be perused
10 and a list put together and the marketing
11 department would be given the task, if you will,
12 of distributing either personally or by mail to
13 those customers on that list.

14 Q. Was there a time period involved in the
15 preparation of the list? And what I'm asking is
16 how far back in time, if you know, did the list
17 go to create the customers?

18 A. By practice it was at least three years prior to
19 date of issuance and any additional past
20 customers that may have purchased the material
21 in a period before that three-year period.

22 Q. Mr. Papageorge, do you recall on July 30, you
23 looked at several product bulletins that
24 Monsanto had produced?

25 A. Yes, sir.

1 Q. When you told us that those bulletins were sent
2 to customers and potential customers of
3 Monsanto, would your testimony that you just
4 described for documents 3585 and 3595 as far as
5 how the customers were determined, would that
6 testimony apply to those product bulletins as
7 well?

8 A. Yes.

9 MR. KLINE: I'm just going to place
10 an objection on the record. I'm still confused
11 as to the definition of customer, and we can
12 either correct it now to eliminate my confusion
13 or wait for me to ask questions. But if we
14 don't correct it sooner rather than later, it is
15 going to require me to ask a lot more
16 questions. And my general confusion is the
17 witness has talked about customers as being
18 direct customers and customers as being indirect
19 customers and then using -- and we're using the
20 general term customers and I want to know if
21 implicit in that use is that NVF would have been
22 a customer of Monsanto versus a customer of an
23 indirect customer which would be a user. I
24 don't want to have to ask him as to each
25 document that we've gone through, is this sent

1 to NVF, was that sent to NVF and the impression
2 given by using the generic term customers is
3 that it was sent to everybody.

4 MR. WARNING: If you go back to the
5 first day, Mr. Papageorge explained what he
6 means when he referred to customers.

7 MR. KLINE: I can refer to Page 68 of
8 the first day of testimony was, there were
9 direct customers which were the users that
10 Monsanto sold directly to. So there was a
11 relationship there between Monsanto and that
12 customer and there were indirect customers which
13 are distributors, the people that didn't use the
14 product but distributed it to others and then he
15 says that they were users, and the users were
16 the people that purchased it from the indirect
17 customers. And NVF obviously is in that
18 category. So by using the term customer
19 generically I still don't know whether we're
20 saying NVF was a customer.

21 MR. LOHMAR: Why don't we ask the
22 witness?

23 MR. WARNING: He's also told us that
24 customer means direct and indirect customer.

25 MR. KLINE: Right, so implicitly that

1 would not be a user as he defined when he
2 defined customers, as being a person not with a
3 relationship with Monsanto who purchased it from
4 a direct customer. That's been my confusion
5 ongoing and I think sooner rather than later we
6 should try to correct this so I can avoid having
7 to go through a myriad of documents.

8 MR. WARNING: I'm not sure something
9 needs to be corrected, but I also don't want you
10 to go through a myriad of documents.

11 MR. LOHMAR: Maybe I could ask two or
12 three questions. You've seen a number of
13 documents where American Mineral Spirits
14 purchased Aroclor, shipped to NVF. Do you
15 recall those documents?

16 THE WITNESS: I do.

17 MR. LOHMAR: Those documents
18 indicated that NVF was actually the end user of
19 the product, did they not?

20 THE WITNESS: Yes.

21 MR. LOHMAR: In such a situation
22 would you consider NVF to be a customer of
23 Monsanto?

24 THE WITNESS: I think the confusion
25 lies in this use of the word "customer," normal

1 customer among Monsanto's team members and the
2 use of the word "customer" as it applied to a
3 formal notification through the mails of some of
4 these notices and documents that we've
5 reviewed. Once an entity appeared on Monsanto's
6 documents as either a sold to or shipped to,
7 they were a known entity to Monsanto. The
8 minute that name appeared, it was picked up in
9 the records as a customer for notifying. Until
10 that name appeared on their record, Monsanto had
11 no idea what entities like Mineral Spirits was
12 selling and where that material was going.

13 MR. LOHMAR: In other words, if I can
14 clarify, if you had a situation where the
15 Aroclors were not only sold to Mineral Spirits
16 but also shipped to Mineral Spirits and they
17 later shipped it to somebody else, in that
18 situation, since you did not know who the end
19 user was they would not appear as a customer?

20 THE WITNESS: That's correct.

21 MR. LOHMAR: And in a dropped shipped
22 to NVF in Kennett Square, Pennsylvania, Monsanto
23 would consider NVF to be a customer for the
24 purpose of notification?

25 THE WITNESS: That's correct.

1 MR. KLINE: Just one question. We
2 looked at a document the first day, it was
3 document 38.

4 MR. LOHMAR: Are you talking about a
5 Bates number?

6 MR. KLINE: Bates number, document
7 38. Off the record.

8 (Discussion off the record)

9 MR. KLINE: Back on record. Mr.
10 Papageorge, placing in front of you what was
11 previously marked as Exhibit 3, I would ask you
12 to take a look at the first page which is Bates
13 numbered NVF 38 and when you're done taking a
14 look let me know.

15 THE WITNESS: I have taken a look at
16 it.

17 MR. KLINE: Do you recall your
18 testimony from the first day concerning that
19 based upon the fact that NVF was the person or
20 entity that Monsanto shipped directly to that at
21 this point in time NVF would have made
22 Monsanto's customer list?

23 THE WITNESS: Yes.

24 MR. KLINE: Now, are you familiar
25 with Monsanto having NVF on its customer list on

1 any date prior to that document from the
2 documents you've reviewed?

3 THE WITNESS: No.

4 MR. KLINE: No further questions.

5 Thanks for that interlude.

6 MR. WARNING: No problem.

7 (Safe handling information
8 marked as Exhibit No. 22
9 for identification.)

10 MR. WARNING: Off the record.

11 (Discussion off the record)

12 MR. WARNING: Back on the record.

13 Q. Mr. Papageorge, you've been handed by the court
14 reporter a group of documents identified as
15 Papageorge Exhibit No. 22. These are documents
16 bearing Bates numbers NVF 3561, 3566, NVF 3569,
17 NVF 3571, and 3573. If you would take a moment
18 to look at those, please?

19 A. I have scanned the documents.

20 Q. Have you seen those documents before, Mr.
21 Papageorge?

22 A. Yes, I have.

23 Q. Could you tell us what they are, please?

24 A. These are copies of toxicity and safe handling
25 information relating to Monsanto's Pydraul

1 products and reflect the various revisions that
2 occurred from time to time.

3 Q. Do you know if those documents were produced in
4 the ordinary course of Monsanto's business?

5 A. They were.

6 Q. Do you know if those documents or copies of them
7 were kept in Monsanto's files?

8 A. They were.

9 Q. Would you be able to date any of those
10 documents? What I mean by date is can you tell
11 us when any of them were prepared?

12 A. The only one I could date is reflected on page
13 NVF 3574, the date April 15, 1960.

14 Q. Mr. Papageorge, do you know if anyone outside of
15 Monsanto would have received any of those
16 documents?

17 A. Yes, customers on Monsanto's list of those who
18 purchased Pydraul F-9, and they were also made
19 available to any potential customer who made
20 inquiries regarding the many Pydrauls discussed
21 in this exhibit.

22 Q. Mr. Papageorge, when a customer of Monsanto that
23 purchased Aroclor products then sold those
24 products to another entity, when Monsanto sold
25 its products to them and when it sent documents

1 such as the ones in front of you, do you know if
2 those customers would forward those documents to
3 their customers?

4 MR. KLINE: Objection, overbroad.

5 You can answer.

6 A. I don't want to mislead here. We are looking at
7 Pydraul --

8 Q. Right.

9 A. -- documents. Pydrauls were sold directly by
10 Monsanto. A distributor would not have been
11 involved. But if a distributor was involved
12 with other Monsanto products, he would be
13 supplied with similar documents and he was
14 encouraged and expected to pass that onto his
15 customers who were unknown to Monsanto.

16 Q. Monsanto encouraged the distributor to pass
17 those along; correct?

18 A. Yes, that's part of the arrangement.

19 Q. That's all I have with that exhibit. Thank
20 you.

21 (Discussion off the record)

22 (Group of documents
23 marked as Exhibit No. 23
24 for identification.)

25 Q. Mr. Papageorge, you've been handed a group of

1 documents identified as Papageorge Exhibit No.
2 23. If you would please take a moment to look
3 at those. And these documents all begin with
4 Bates numbers NVF 3231, 3310, 3325, 3372, 3393,
5 3441, 3481, 3503, and 3511. Gerard, I believe
6 these are documents identified previously in my
7 letter last week.

8 A. I have scanned the documents in the exhibit.

9 Q. Mr. Papageorge, have you seen those documents
10 before?

11 A. Yes, I have.

12 Q. Could you tell us what they are, please?

13 A. This is a collection of brochures describing
14 Monsanto's hydraulic fluids sold under the trade
15 name Pydrauls and includes two pamphlets, the
16 one beginning with NVF 3503 and other beginning
17 with NVF 3511, which describe some thoughts that
18 Monsanto had regarding the conversion of
19 existing systems for the use of Monsanto's
20 Pydraul fluids.

21 Q. Mr. Papageorge, would you be able to put a date
22 on any of those documents as far as when they
23 were prepared?

24 A. I note that some of them do have a date, for
25 example, on the page NVF 3253, in the lower

1 right-hand corner there is a date, but it's not
2 very clear. And the date is part of a string of
3 letters and digits, it appears, although I'm not
4 certain. I see 1, 2, 6, 4 which would indicate
5 that December of '64, but that could be '54
6 also. It's not clear. On the page NVF 3313,
7 again the digits at the lower left-hand corner
8 are not clear, but it appears to be January of
9 some year represented by two digits that I
10 cannot read. On the page NVF 3408 I see the
11 date zero eight which would be August, '68,
12 which would be 1968. On the page NVF 3456 I
13 have a difficult time reading the date but it's
14 the first four digits in the lower right-hand
15 corner. It appears like June '69, but I'm not
16 certain. Page NVF 3510 lower left-hand corner
17 the digits are unreadable to me. I can find no
18 other references to dates.

19 Q. Mr. Papageorge, do you know if those documents
20 were prepared in the ordinary course of
21 Monsanto's business?

22 A. They were.

23 Q. And do you know if the originals or copies of
24 those documents were kept in Monsanto's files?

25 A. They were.

1 Q. Do you know if anyone outside of Monsanto would
2 have received copies of any of those documents
3 in that exhibit?

4 A. Yes.

5 Q. Who would have received them?

6 A. Customers of the Pydrauls purchased from
7 Monsanto who were on record as having been
8 Monsanto customers, and again, any potential
9 customers that might exhibit an interest in this
10 type of product.

11 Q. That's all I have for that exhibit.

12 (Group of documents
13 marked as Exhibit No. 24
14 for identification.)

15 Q. Mr. Papageorge, you've been handed several
16 documents that have been identified as
17 Papageorge Exhibit No. 24. These documents
18 contain Bates numbers NVF 3204 and 3217. If
19 you'll take a moment to look at those, please.

20 A. I have scanned the documents.

21 Q. Have you seen those documents before, Mr.
22 Papageorge?

23 A. Yes, I have.

24 Q. Could you tell us what they are, please?

25 A. They are copies of product technical bulletins

1 of a Monsanto product describing the use of the
2 product Aroclor 1248 as a hydraulic fluid in die
3 casting systems.

4 Q. Do either of these two documents have dates?

5 A. Yes, they both have dates. In the upper
6 right-hand corner the document that starts with
7 NVF 3204 is dated March 28, 1949. The document
8 that starts with page NVF 3217 in the upper
9 right-hand corner has a date May 1, 1950.

10 Q. Mr. Papageorge, do you know if these documents
11 were prepared in the ordinary course of
12 Monsanto's business?

13 A. They were.

14 Q. Do you know if the originals or copies of them
15 were kept in Monsanto's files?

16 A. Yes, they were.

17 Q. Do you know if anyone outside of Monsanto would
18 have received copies of those documents?

19 A. Yes.

20 Q. Do you know who would have received copies of
21 those documents?

22 A. These particular documents would have been made
23 available to those who had die casting systems
24 and that Monsanto hoped would be interested in
25 this particular product for use in that system.

1 Q. That's all I have with that exhibit.

2 MR. WARNING: Off the record a
3 moment.

4 (Discussion off the record)

5 (Sales summary
6 marked as Exhibit No. 25
7 for identification.)

8 Q. Mr. Papageorge, I'm handing you several
9 documents that have been identified as
10 Papageorge Exhibit No. 25. If you would take a
11 moment to look at those, please?

12 (Brief recess.)

13 A. I have reviewed the exhibit.

14 Q. Have you seen these documents before in Exhibit
15 No. 25, Mr. Papageorge?

16 A. Yes, I have.

17 Q. Could you tell us what they are, please?

18 A. These represent four different summaries, sales
19 summaries in which an attempt is made to review
20 the sales to NVF at different locations going
21 back to the 1950s.

22 Q. For the record, the Bates numbers for these
23 documents are NVF 1318, and 21. Mr. Papageorge,
24 do you know if these documents were produced in
25 the ordinary course of Monsanto's business?

1 A. Yes.

2 Q. Do you know if the originals or copies of them
3 were kept in Monsanto's files?

4 A. Yes.

5 Q. Do you know how these documents were put
6 together?

7 A. I have problems with the how part. You mean
8 physically handled or --

9 Q. I'll try to be more specific. Do you know if a
10 certain department or division within Monsanto
11 compiled these records?

12 A. The attachments to each of the three separate
13 summaries for four separate summaries are
14 maintained by Monsanto, or were maintained by
15 Monsanto's marketing department. I do not know
16 who prepared the cover sheet and attempts to
17 summarize the different periods of time.

18 MR. KLINE: Off the record.

19 (Discussion off the record)

20 Q. Mr. Papageorge, would you look at page NVF 2,
21 please?

22 A. What was that number again?

23 Q. Two?

24 A. I have it.

25 Q. Do you see near the upper right-hand corner

1 there is a date December, 1965?

2 A. I do.

3 Q. Do you know if that was when this document was
4 prepared?

5 A. No. I know it was not prepared in December. It
6 includes information through December '65 which
7 implies preparation in early '66.

8 Q. Would this document have been prepared within a
9 year after December, 1965, if you know?

10 A. Yes, definitely.

11 Q. Mr. Papageorge, because this document includes
12 reference to NVF company in 1965, having been
13 prepared as you just testified in 1966, does
14 that mean NVF company would have been on the
15 customer list you have referred to previously in
16 your deposition in 1966?

17 A. In 1966, yes, but you may remember we discussed
18 the three-year period plus any other key
19 customers added to that three years, so the
20 existence on a list will change with time.

21 Q. Would you explain what you mean by the existence
22 on the list will change with time?

23 A. I'm referring to a working copy of a customer
24 list in Monsanto personnel's files, it would
25 reflect those customers that were three years

1 plus some additional which may cover a three to
2 six-year period. If the customer had not
3 purchased anything for 10 years, the customer's
4 name would drop from that list.

5 Q. So the fact that Monsanto -- strike that -- NVF
6 appeared on a sales summary prepared sometime in
7 the year 1966, what does that tell you about
8 NVF's appearing on the customer list?

9 MR. DAVIDSON: Let me ask you to
10 clarify something. Earlier today you asked him
11 about some safety and handling sheets dating
12 back to '64, '66. You and he discussed to whom
13 those might have been mailed. In the previous
14 session of the deposition we talked specifically
15 about Aroclor warning letters and the lists that
16 were prepared and administered under Mr.
17 Papageorge's direction. I think you need to
18 distinguish exactly what list you're talking
19 about.

20 Q. Mr. Papageorge, the list of -- strike that. The
21 sales summary in NVF document No. 2 which was
22 prepared sometime during the year 1966, was
23 there a list that the company appearing on
24 document NVF 2, which is NVF, is there a list
25 that that company would have been put on by

1 virtue of being on this document?

2 A. At that time or when?

3 Q. At any time?

4 A. At any time. The customer of record list would
5 include this reference in 1966 once it was
6 picked up as a customer, and it would stay on
7 that list for at least three years. If someone
8 in the marketing organization perceived this as
9 a key customer, a very valuable contact, he
10 would maintain his own list out in his office in
11 the field, the name of that entity.

12 Q. This customer list you are referring to, was
13 that the same list that was used for the warning
14 letters that we discussed on July 30?

15 A. It was certainly a basis for pulling together
16 the thousands that were sent this warning letter
17 in early 1970, yes, that was a key source of
18 information.

19 Q. Mr. Papageorge, if you would look at document
20 NVF 9, please?

21 A. I have it.

22 Q. Do you see up in the right-hand corner a date
23 D-E-C, 1962?

24 A. I do.

25 Q. Do you know when this document would have been

1 prepared?

2 A. Early 1963.

3 Q. Do you see near the middle of that document
4 reference to N-A-T-L vulcanized F-I-B-R?

5 A. I do.

6 Q. Because that entity appears on this document,
7 does that mean that this document would have
8 been used to create or update a customer list
9 which would have included that entity?

10 A. I'm getting confused because I don't think I'm
11 explaining it clearly. In 1962, as an example,
12 a record of customers would have included
13 National Vulcanized F-I-B-R that we talked about
14 earlier, and it would have stayed on that list,
15 of course it's in '63 when this was documented,
16 it would have stayed on the list in '64 and '65,
17 maybe '66. And if no further sales were
18 recorded, very likely the name of that customer
19 would be dropped from the list and therefore it
20 would not have shown up in the 1970 mailing.

21 Q. Mr. Papageorge, would you look at NVF 4, please?

22 A. Yes, I have it.

23 Q. Do you see in the upper right-hand corner a date
24 D-E-C '59?

25 A. I do.

1 Q. Do you know when this document would have been
2 prepared?

3 A. Early 1960.

4 Q. Do you see near the middle N-A-T-L Vulcanized
5 F-I-B-R?

6 A. I do.

7 Q. Again, because that entity appears on this
8 document, would that mean that they would appear
9 as of this date the date I'm referring to being
10 early 1960, they would appear on a customer
11 list?

12 A. Yes.

13 Q. That's all I have with that exhibit. Thank
14 you.

15 MR. WARNING: Off the record.

16 (Discussion off the record)

17 Q. Mr. Papageorge, would you take a look back on
18 Papageorge Exhibit No. 25, please, document NVF
19 21?

20 A. I have it.

21 Q. Do you see on that document an entry which
22 states 1958 dash 1970?

23 A. I do.

24 Q. Do you see where it says, no sales found for
25 these years?

1 A. Yes.

2 Q. Am I correct in saying that this document
3 represents a sales summary for NVF Company,
4 Kennett Square, Pennsylvania?

5 A. It does.

6 (Shipping report
7 marked as Exhibit No. 26
8 for identification.)

9 Q. Mr. Papageorge, you've just been handed a
10 document that has been identified as Papageorge
11 Exhibit No. 26 and contains Bates number NVF
12 112. Would you take a moment to look at that?

13 A. I have reviewed it.

14 Q. Have you seen this document before, Mr.
15 Papageorge?

16 A. Yes.

17 Q. Could you tell us what it is, please?

18 A. This is a Monsanto document used within Monsanto
19 to prepare a shipment of product to a customer.

20 Q. Do you see near the middle of that document a
21 box that says, shipped to?

22 A. Yes.

23 Q. And says, NVF Company?

24 A. Yes.

25 Q. Does this document indicate that 32,400 pounds

1 of Aroclor 1254 was shipped to NVF Company on
2 August 13, 1970?

3 A. It does, uh-huh.

4 Q. And if you go back to NVF 21 --

5 A. I have it.

6 Q. -- that you just looked at, the item 1958
7 through 1970 where it says no sales found for
8 these years?

9 A. Right; I see that.

10 Q. The fact that NVF received 32,400 pounds of
11 Aroclor 1254 which was shipped to them August
12 13, 1970, but it does not appear on NVF 21, is
13 that due to the fact that American Mineral
14 Spirits Company was the customer for the
15 transaction of August 13, 1970?

16 A. I'm under an impression it would have been
17 picked up for the shipped to location. Not
18 knowing how this document, NVF 21, was put
19 together, I don't know why it wasn't included as
20 a shipment to the Kennett Square location. I
21 just can't help you on that. I don't know.

22 Q. That's all I have with that. Mr. Papageorge, do
23 you know if one form of Aroclor such as Aroclor
24 1254 when exposed to the environment can break
25 down to another form of Aroclor such as Aroclor

1 1248?

2 A. I'm only aware of the situation where the
3 original Aroclor is modified by the environment
4 whether it be by the chemicals or bacteria,
5 whatever agent causes that change, the only
6 change that I have been able to learn about and
7 get familiar with is the change where the
8 Aroclor goes up in Aroclor number. In other
9 words, it will contain the higher chlorinated
10 types of PCBs which are the more difficult to
11 change, so your example of Aroclor 1254 going
12 down to Aroclor 1248, I have no evidence that
13 this happens. It's never been found.

14 Q. Mr. Papageorge, those are all the questions I
15 have. Thank you very much.

16 A. Thank you.

17 MR. WARNING: Off the record.

18 (Discussion off the record)

19

20 EXAMINATION

21 QUESTIONS BY MR. LOHMAR:

22 Q. My name is Doug Lohmar, and I also represent one
23 of the insurance companies who for some
24 unfathomable reason NVF is suing in the state of
25 New Jersey. I have a number of questions. As

1 you know, I've been sitting here about a day and
2 a half and I want to get a clearer understanding
3 of some of the things you've testified. You've
4 testified to the customer list and the
5 maintenance of a customer list. There was a
6 separate customer list for each product that
7 Monsanto sold, was there not?

8 A. Yes.

9 Q. So you would have a customer list, for example,
10 for Aroclor 1248 and a separate list for Aroclor
11 1254?

12 A. Yes.

13 Q. And bulletins sent to people who purchased 1248
14 may not be sent to people who purchased 1254?

15 A. It depends on the type bulletin.

16 Q. A bulletin specific to Aroclor 1248 would be
17 sent to the customers of 1248?

18 A. Correct.

19 Q. You also mentioned that on a periodic basis
20 Monsanto would purge its customer list; correct?

21 A. Do what, sir?

22 Q. Would purge the customer list?

23 A. Yes.

24 Q. Of people who had not bought the product for a
25 certain period of time?

1 A. Yes.

2 Q. Was that something that was automatically done?

3 A. Yes, sir. The procedure was such that those
4 responsible for preparing the list were given
5 guidelines in terms of customers to keep on the
6 list and the period of time on which they would
7 base their judgment call as to whether or not to
8 keep that customer or drop it because it became
9 an unimportant piece of information.

10 Q. Are these guidelines still available?

11 A. I don't know.

12 Q. When was the last time you saw these guidelines?

13 A. About 1975 or so.

14 Q. So you haven't seen them for the last 20 some
15 years?

16 A. That is true.

17 Q. I would like to show you a document here.

18 Brett, I gave you copy of it. Maybe you can
19 show your copy. I'm going to ask the court
20 reporter to mark this document as Papageorge
21 27. It looks like a four-page letter from Mr.
22 John H. Craddock to Dr. William Lair dated June
23 16, 1986. And if you could take a moment to
24 look at that document, I would appreciate it.
25 This document is Bates stamped 10029 through

1 31.

2 (Letter dated 6/16/86
3 marked as Exhibit No. 27
4 for identification.)

5 MR. KLINE: I would like to note for
6 the record and for the witness' benefit that the
7 handwriting on pages of this document is not
8 Monsanto handwriting.

9 MR. LOHMAR: We don't know that. We
10 have one witness who testified it's his; that's
11 true.

12 MR. KLINE: That witness is not with
13 Monsanto.

14 A. I have reviewed the exhibit.

15 Q. Sir, have you seen the first page of this
16 document before today?

17 A. No, I haven't.

18 Q. Are you familiar with a John H. Craddock?

19 A. Yes.

20 Q. How are you familiar with Dr. Craddock?

21 A. Well, he reported to me at one time as one of
22 the team. He's involved in environmental
23 matters at Monsanto.

24 Q. So Dr. Craddock would have had the position of
25 product and environmental safety director of

1 Monsanto in the Environmental Safety and Health
2 Staff on or about June of '86?

3 A. Correct.

4 Q. And you were familiar with him because he was a
5 fellow employee at that time?

6 A. Yes, at that time he was reporting to me in
7 1986.

8 Q. In this cover letter, sir, Dr. Craddock states,
9 and I quote, "Sales records of this duration are
10 not usually maintained as a routine course;
11 therefore, I am not sure of their
12 completeness." Do you see that sentence?

13 A. I do.

14 Q. Do you agree with Dr. Craddock's representation
15 regarding the completeness of sales records from
16 the period of 1954 through 1977?

17 A. That's true.

18 Q. So the records that have been produced by
19 Monsanto here are simply the documents available
20 to Monsanto for that period of time?

21 A. Correct.

22 Q. And since sales records were not maintained as a
23 routine course, the completeness of the
24 information provided regarding shipments
25 Monsanto made to NVF is unknown?

1 A. Yes, but you'll note that it says sales records
2 of this duration are not routinely or not
3 usually maintained.

4 Q. Based on what you just said, what is your
5 understanding of the term "this duration"?

6 A. Especially the early years, the 1950s, the
7 system was not as efficient, let me call it, as
8 it was in the '70s.

9 Q. But we've already seen your -- here's one
10 shipment of 32,400 pounds made in 1970 that for
11 some reason was not included in the sales
12 summary?

13 A. At least on this one I have. It may appear on
14 another summary.

15 Q. And you've seen exhibit -- as one of the
16 deposition exhibits, summaries that Monsanto has
17 provided to us from its record, have you not?

18 A. That's true.

19 Q. And the August 13, 1970, shipment was not on
20 those summaries; correct?

21 A. Not under NVF, correct.

22 Q. Is there some way to trace, sir, where on the
23 sales summary the shipment identified on NVF
24 000112 would be recorded?

25 A. 00112?

1 Q. Right.

2 A. That's this one?

3 Q. In other words, is there something on this
4 document which would tell us where in Monsanto's
5 sales summary records this shipment would be
6 recorded?

7 A. If it didn't appear on the NVF summary, I would
8 go back on the system and look it up under
9 American Mineral Spirits.

10 Q. That's because American Mineral Spirits is the
11 sold to; correct?

12 A. Correct.

13 Q. Sir, I'm going to hand you -- will you take a
14 look at the Exhibit No. 25, I believe, there are
15 NVF, the Monsanto sales summaries to NVF?

16 A. Uh-huh.

17 Q. I note, for example, sir, on the document that
18 is Bates stamped number NVF 000004?

19 A. I have it.

20 Q. Do you see the code that appears in the far
21 left-hand column in the computerized printout in
22 the bottom half of the Page 515447?

23 A. I see the 51544 something; is that a T or a
24 seven? I don't know. It's some handwritten --

25 Q. Is it handwritten on your copy, sir?

1 A. I'm sorry, it's a seven. It's blurred. It is a
2 seven.

3 Q. Does that number have some significance to you?

4 A. It did at one time. It refers to that customer,
5 but that's all I recall.

6 Q. Sir, today we've talked about a number of
7 various salespeople?

8 MR. DAVIDSON: Are you finished with
9 those?

10 MR. LOHMAR: I believe so, yes.
11 Thank you, sir.

12 Q. I do have one other question going back to the
13 letter of Dr. Craddock.

14 A. I have it.

15 Q. In the final sentence of the second to last
16 paragraph, Dr. Craddock states, quote, "A void
17 does not necessarily mean no sales occurred, it
18 only means no records are still available." Do
19 you see that?

20 A. Yes.

21 Q. Do you agree with Dr. Craddock's statement
22 there?

23 A. Yes.

24 Q. So when Dr. Craddock in the attachments
25 represents no sales found for these years, he

1 means Monsanto simply had no records for these
2 sales?

3 A. That is true.

4 Q. Or at least had no records it could find?

5 A. That's correct.

6 Q. He didn't mean to represent that no sales had
7 actually taken place?

8 A. That is correct.

9 Q. Thank you, sir. Sir, is there any way to
10 determine when a specific customer would be
11 dropped from a specific customer list?

12 A. A way to determine it?

13 Q. Let me make it a little easier for you. Did
14 Monsanto maintain records, let's say periodic
15 records of who would be on the list for a
16 certain calendar year?

17 A. They would prepare lists on a periodic basis and
18 that period depended on the opinion of the
19 individual in Monsanto assigned that particular
20 product, and his knowledge of the activity in
21 that kind of product sales would help him
22 determine that a new list was in order or the
23 old list is still a good list. So there was no
24 set ground rule that says on such a day of the
25 year you must correct your list. And therefore

1 the lists would vary from annually reviewing to
2 maybe a five-year period or ten-year period. It
3 depended on the type of product.

4 Q. Did Monsanto keep copies of each list that it
5 had for each product for each period of time
6 that list was used?

7 A. Monsanto as part of their record keeping program
8 kept those for periods of time that I don't
9 remember anymore. They were not kept forever.

10 Q. Do you know how many of these lists currently
11 exist today?

12 A. No, I don't.

13 Q. Sir, earlier you testified that Mr. CP Farley
14 was at one time an employee of Monsanto;
15 correct?

16 A. Correct.

17 Q. Do you know if Mr. Farley is still alive today?

18 A. Yes, he is.

19 Q. Do you know where he lives?

20 A. In the St. Louis area as close as I could come.

21 Q. Do you know if he's still an employee of
22 Monsanto?

23 A. No, he's retired.

24 Q. You also testified Mr. Clark was Mr. Farley's
25 immediate supervisor at one time?

1 A. Yes.

2 Q. Do you know if Mr. Clark is still alive today?

3 A. I don't know.

4 Q. Do you know where he lived at the time he was an
5 employee at Monsanto?

6 A. Mr. Clark, in the St. Louis area.

7 Q. Do you know Mr. Clark's first name?

8 A. Willis, W-I-L-L-I-S.

9 Q. Do you happen to know his middle initial?

10 A. No, I don't.

11 Q. You also mentioned a John M. Van Gunder was at
12 one time an employee or salesperson for
13 Monsanto?

14 A. Yes.

15 MR. WARNING: I believe it was Van
16 Gelder.

17 MR. LOHMAR: Thank you.

18 Q. Do you know if Mr. Van Gelder is still alive
19 today?

20 A. I do not know.

21 Q. Do you know where he lived at the time he was
22 working for Monsanto?

23 A. Mr. Van Gelder had many different assignments
24 throughout the country, so his address kept
25 changing. I just don't really know exactly

1 where he lived.

2 Q. When he was working as a marketing rep servicing
3 a client in southeastern Pennsylvania, I will
4 tell you it's southeastern Pennsylvania, do you
5 know where he was working out of at that time?

6 A. Wilmington, Delaware.

7 Q. Did NVF -- strike that. Did Monsanto at the
8 time have an office in Wilmington, Delaware?

9 A. Yes.

10 Q. Was that a sales office?

11 A. It was a district sales office.

12 Q. Do you know if it still has such a district
13 sales office?

14 A. No, I don't.

15 Q. Do you know the address of that district sales
16 office?

17 A. You might find it in some of these bulletins, in
18 the back page.

19 Q. You also mentioned a Mr. JH Orem who was at one
20 time -- you also mentioned Mr. Orem who was an
21 employee of Monsanto?

22 A. Yes.

23 Q. Do you know if Mr. Orem is still alive today?

24 A. I do not.

25 Q. Do you know his first name?

1 A. I don't remember it.

2 Q. At the time Mr. Orem was working for Monsanto
3 did he also work out of the St. Louis office?

4 A. He did at one time, but he was also out in the
5 district offices. I don't know the timing,
6 however.

7 Q. Sir, we spent a lot of time talking about the
8 Monsanto product known as Pydraul. Did Pydraul
9 contain any Aroclor products?

10 A. At one time, yes.

11 Q. What time was that, sir?

12 A. What time -- from the middle '50s to about 1971
13 or 2.

14 Q. Do you know what type of Aroclor Pydraul
15 contained?

16 A. It depended on the Pydraul; sometimes it was
17 Aroclor 1242, sometimes Aroclor 1248.

18 Q. Would it help if I told you it was Pydraul F-9?

19 A. Not very much. I would have to review the
20 recipe for all of these to determine which
21 ingredients were mixed together to make the
22 final product.

23 Q. When NVF -- strike that. When Monsanto would
24 have technical bulletins dealing with --

25 MR. DAVIDSON: Could we go off the

1 record?

2 (Discussion off the record)

3 MR. LOHMAR: Back on the record.

4 Q. Sir, since Pydraul contained certain Aroclors,
5 would customers who ordered Pydraul receive the
6 technical bulletins related to those Aroclors?

7 MR. KLINE: Objection, receive from
8 whom?

9 MR. LOHMAR: Receive from Monsanto.
10 Let me rephrase the question to satisfy Mr.
11 Kline.

12 Q. Since certain Pydrauls contained certain
13 Aroclors, would the Monsanto customers of those
14 Pydrauls receive the technical bulletins from
15 Monsanto that related to those Aroclors?

16 A. Not likely.

17 Q. Why is that, sir?

18 A. The bulletins and brochures prepared for the
19 Pydrauls attempted to address the very issues
20 that the Aroclor bulletins addressed regarding
21 handling and exposure and the like. I don't
22 know at any time whether many customers were
23 even aware of which of the Aroclors were present
24 in the Pydraul. They were just told this is a
25 complex mixture, handle it this way. So the

1 brochures for Aroclors very unlikely did not go
2 to the Pydraul customers.

3 Q. Thank you, sir. Sir, Mr. Warning asked you
4 questions about whether the Aroclor over time
5 could change in the environment from one
6 numbered Aroclor to another numbered Aroclor.
7 Do you know of any circumstances where a certain
8 Aroclor, say Aroclor 1248, would degrade into
9 some other substance in the environment?

10 MR. KLINE: Objection, vague; are you
11 asking him some other non PCB substance?

12 MR. LOHMAR: My question stands.

13 A. When you use the word "degrade," I have a little
14 trouble because each of us may have a different
15 definition of degrading. I would suggest in my
16 mind it refers to is there a chemical change
17 that takes place.

18 Q. Let me make it a little more specific. Do you
19 know of a certain situation where a certain
20 Aroclor would change its chemical composition at
21 any time due to the exposure to the environment?

22 A. There is evidence that that does happen and what
23 does happen varies with the conditions to which
24 this Aroclor was exposed.

25 Q. Excluding the testimony you've already given

1 where a certain Aroclor would increase the
2 amount of chlorine and actually rise in number
3 from let's say Aroclor 1248 to a higher number,
4 do you know of any other circumstance where
5 Aroclor due to exposure to the environment would
6 change its chemical composition?

7 A. When you excluded that other example, you left
8 out the resulting products that did appear.

9 Q. Do you know what kinds of resulting products
10 those would be?

11 A. Those products, to my knowledge, have never been
12 identified. When the sample of Aroclor is put
13 through an analytical system, it doesn't pick up
14 these new chemicals that were generated. It
15 just picks up a fingerprint of an Aroclor.

16 Q. Sir, I believe you testified on the first day
17 that Aroclor 1254 was not commonly used as a
18 heat transfer system; do you remember that?

19 A. I do.

20 Q. What was the more common use of Aroclor 1254?

21 A. Aroclor 1254 was, I suppose when you say the
22 most common use, it was an ingredient in
23 electrical equipment fluids.

24 Q. When you say electrical equipment fluids are you
25 talking about transformers?

1 A. Primarily transformers, but also some electric
2 switch gear.

3 Q. Would there be any reason for an industrial user
4 to want to combine two different kinds of
5 Aroclors together?

6 A. Yes, in fact I'm trying to recall, I believe we,
7 Monsanto, sold some of those blends and the
8 intent was to try to get a certain property they
9 were looking for such as fluidity, too viscous,
10 is it too thin, we want something in between
11 that sort of property, so at times this was
12 done.

13 Q. Do you know if end users would actually buy two
14 kinds of Aroclors and blend them themselves to
15 obtain a certain result?

16 A. That was possible. I would never know what they
17 did once the material arrived at their plant
18 gate.

19 Q. Through your communications with various
20 customers of Monsanto, do you recall any of them
21 telling you that they actually blended two kinds
22 of Aroclors together to reach a certain
23 viscosity or attain a certain pressure or
24 temperature or any other purpose?

25 A. Not to me personally, I don't recall any such

1 discussion.

2 Q. Are you familiar with the term
3 "bioaccumulation"?

4 A. Yes.

5 Q. Are you familiar -- are you familiar with that
6 term?

7 A. I can give you an example where, let's take PCBs
8 as an example, entered the environment and
9 they're present in concentrations that are
10 extremely dilute, takes sophisticated
11 instruments to detect. There are creatures out
12 there in that environment that consume some of
13 these PCBs; it builds up in their systems.
14 These creatures in turn are eaten by bigger
15 creatures in an aquatic environment, for
16 example, you end up with the biggest fish in the
17 river having a lot more PCBs in its tissue than
18 what appears in the water itself. And it builds
19 up because of this bioaccumulation phenomenon.

20 Q. When did Monsanto first learn that PCBs, for
21 example, would bioaccumulate in aquatic life,
22 fishes?

23 A. As best I can remember it was late 1970, early
24 '71.

25 Q. About the same time that Monsanto realized there

1 was the environmental hazard associated with
2 PCBs?

3 A. When you use the word "hazard," I don't know
4 that it had been established yet. Presence,
5 yes, it was out there and it was present in
6 higher quantities in some samples than others,
7 this kind of thing, but the hazard, I don't know
8 that in 1970, '71 it was established that in
9 truth it was a hazard.

10 MR. WARNING: You just a moment ago
11 said late 1970s or early '71. Did you mean late
12 1960s or early '71 when you identified the time
13 period?

14 THE WITNESS: I thought we were
15 talking about bioaccumulation.

16 Q. (By Mr. Lohmar) Wasn't it your testimony that
17 Monsanto realized about the bioaccumulation in
18 approximately late 1970 or early 1971?

19 A. The bioaccumulation, yes, not presence.

20 MR. WARNING: Thank you.

21 Q. Sir, by 1970 wasn't Monsanto alerting its
22 customers of the potential environmental
23 problems associated with PCBs?

24 A. Correct.

25 MR. KLINE: Are you saying before

1 1970?

2 MR. LOHMAR: The question speaks for
3 itself, sir.

4 MR. KLINE: I object as vague.

5 Q. (By Mr. Lohmar) When you say -- I want to make
6 sure we're not dealing with environmental
7 semantics. We've talked about PCB presence, PCB
8 hazard, PCB problems. Let's make it June 1,
9 1970, Monsanto was alerting certain of its
10 customers there were potential environmental
11 problems with PCBs; correct?

12 A. Correct.

13 Q. What was the problem that Monsanto saw with PCBs
14 in the environment at that time?

15 A. It's the presence of an environmental -- sorry.
16 It's the presence in the environment of an
17 industrial chemical that in Monsanto's opinion
18 should not exist in those samples that were
19 reported as containing this chemical, PCBs, and
20 I think I referred earlier to the presence in
21 fish out of nonindustrial waters, the presence
22 in pine needles up in Sweden, those were
23 disturbing to Monsanto. They could not explain
24 that presence based on their knowledge of the
25 material at the time and where it was used.

1 Q. Sir, I want to show you a document that has been
2 marked Bates numbered NVF 00111 and I apologize
3 if you've seen it before. I'll have it marked
4 as Papageorge 28. I think it was earlier marked
5 in a group exhibit.

6 (Addressee list
7 marked as Exhibit No. 28
8 for identification.)

9 Q. Sir, do you recognize that document?

10 A. Yes, I do.

11 Q. What is that document, sir?

12 A. This is a redacted copy of an addressee list of
13 a mailing that took place in late '71.

14 Q. Do you know what mailing that document refers
15 to?

16 A. Not offhand. I would have to see other
17 supporting documents.

18 Q. I notice, sir, that the mailing seems to have a
19 handwritten date for date mailed of October 30,
20 1971. Do you see that, sir? Is that how you
21 read it, the date? Maybe you read a different
22 one?

23 A. That could be a zero for October or a 2 for
24 December. It's late '71 is the way I interpret
25 that.

1 Q. Obviously a double digit month?

2 A. Correct.

3 Q. Sir, would the letter that that mailing refers
4 to be also dated that date?

5 A. On or about. It might be a little earlier.

6 Q. Sir, you've seen a document today and again it's
7 NVF 000112 --

8 MR. DAVIDSON: Exhibit 26.

9 MR. LOHMAR: Let the record reflect
10 the witness and I are both referring to Exhibit
11 26.

12 Q. When this shipment went out on August 13, 1970,
13 what literature would also be sent to NVF at
14 that time?

15 MR. KLINE: Objection; withdraw the
16 objection.

17 A. The literature, there would be a bill of lading.

18 Q. Let me be a little more specific, sir. You
19 testified earlier that the technical bulletins,
20 for example, would be sent to various customers
21 at various times; correct?

22 A. Correct.

23 Q. Assuming NVF for some reason was not on a
24 customer list before August 13, 1970, for this
25 particular product, what information would NVF

1 send to -- what information would Monsanto send
2 to NVF now that NVF has purchased this product?

3 A. I don't know what transpired. I don't know if
4 someone in Monsanto's organization contacted
5 American Mineral Spirits or while they were
6 talking to American Mineral Spirits to make this
7 shipment what discussion was held about is this
8 a new customer, does he have the literature,
9 should we send it to him or will you send it, so
10 I don't have enough information to know what was
11 sent along with this shipment regarding
12 literature. It all depends on what the
13 individuals involved understood, NVF's
14 familiarity with this material.

15 Q. Well, assuming, that NVF was not familiar with
16 this material, what literature would be sent at
17 that time?

18 MR. KLINE: Objection, calls for
19 speculation.

20 A. For the particular material and the
21 understanding of its use which could vary with
22 each individual, the very -- it's highly likely
23 that the pamphlet or brochure they would have
24 received is the one in which the Aroclor
25 plasticizers are described which is the brochure

1 that covers all those applications and the
2 physical properties and the handling
3 information.

4 Q. Let me see if I can be a little more specific.
5 Would the technical bulletin that was being used
6 for Aroclor 1254 have been shipped to NVF on or
7 about August 13, 1970, if Monsanto's records
8 indicated that it had not been sent before?

9 A. Not necessarily.

10 Q. Why not, sir?

11 A. Like I tried to indicate earlier, it depended on
12 the communications received from American
13 Mineral Spirits because the American Mineral
14 Spirits Company was in a position to supply that
15 information to its customer, NVF Company, long
16 before they placed this order with Monsanto.

17 Q. But Monsanto would have somehow checked, would
18 it not?

19 MR. KLINE: Objection, leading.

20 MR. LOHMAR: Excuse me, it's not my
21 witness.

22 Q. Monsanto would have checked to insure that
23 somehow the technical bulletin for this product
24 would have been sent to NVF?

25 A. That is the normal procedure for these kinds of

1 arrangements.

2 Q. We've also seen a number of advisory letters
3 that were sent to various Monsanto customers
4 advising them of potential environmental hazard
5 associated with certain Aroclors. Do you
6 remember seeing those during your first day of
7 testimony?

8 A. I do.

9 Q. Would it have been Monsanto's standard practice
10 to also insure those letters would have been
11 sent to NVF on or about or before August 13,
12 1970?

13 MR. KLINE: Before you answer the
14 question, I object.

15 MR. LOHMAR: The objection is noted.

16 MR. KLINE: I want to state the basis
17 of the objection. It's overbroad. I'm going to
18 -- you're asking him to testify as to
19 Monsanto's practice --

20 MR. LOHMAR: What is your objection?

21 MR. KLINE: It's an unfair question.

22 MR. LOHMAR: Now you can answer the
23 question.

24 A. I've forgotten the question.

25 MR. LOHMAR: I'm not going to have

1 you lead the witness through your objection.

2 MR. KLINE: You haven't identified
3 the subject matter of the question. You've
4 referred to a lot of notices.

5 MR. LOHMAR: I've forgotten the
6 question. Would you read it back?

7 Q. NVF 00112 indicates a shipment of Aroclor being
8 made August 13, 1970, does it not?

9 A. It does.

10 Q. Was it Monsanto's practice at that time to send
11 the various letters that you've testified about
12 to the ship to addresses for Aroclor shipments
13 that were made in 1970?

14 MR. KLINE: Dated prior to this
15 date?

16 MR. LOHMAR: My question stands.

17 MR. KLINE: The question is
18 completely ambiguous.

19 MR. LOHMAR: Let me make it clear.

20 Q. We have seen various letters dated in May of
21 1970 and if you want me to, I can walk you
22 through those letters.

23 A. Early part of 1970.

24 Q. Let's make it easier for you, sir. This
25 shipment was on August 13, 1970, was it not?

1 A. Correct.

2 Q. Had Monsanto advised its customers of the
3 environmental problems associated with Aroclor
4 1254 prior to August 13, 1970, would it also
5 have so advised a customer who purchased Aroclor
6 1254 on August 13, 1970?

7 A. If Monsanto was in a position of understanding
8 that this customer had not been advised, that
9 would have been done. If, however, the entity
10 American Mineral Spirits that placed the order
11 and was in a position to share that very data
12 and instructed to do so, if they had already
13 done that, Monsanto would not have repeated
14 that.

15 Q. So the only time Monsanto would not have sent it
16 is if they had some type of assurance that NVF
17 had already received the information?

18 A. Correct.

19 Q. Sir, we've seen a number of letters that do not
20 appear to have an addressee indicated on the
21 letters. Do you remember those from your first
22 day of testimony?

23 A. Yes.

24 Q. Why was it that Monsanto's letters would contain
25 a copy of the letter that did not have the

1 specific addressee on it?

2 A. The decision, sir, was made to keep a copy of
3 the letter without the addressees in the event
4 someone had to refer to it, but the addressees
5 were documented on the page that was typed with
6 these adhesive labels. And it was actually a
7 double typing, one to place this adhesive label
8 as the addressee and the other to put on the
9 envelope. And those typed adhesive backed
10 labels were photographed as the list of
11 customers that were -- that received the
12 mailing. That copy of the addressees was placed
13 with the unaddressed copy of the letter and that
14 was the file for that particular mailing.
15 Otherwise it would have resulted in thousands of
16 letters, much more difficult to retrieve and
17 store and so on.

18 Q. Sir, are you familiar with the term "friction
19 losses"?

20 A. Friction losses, I'm familiar with it but not in
21 depth.

22 MR. LOHMAR: Brett, would you see if
23 you can find this particular document, Bates
24 number 1758? If you could also find 1719. I'm
25 going to be asking you to explain the charts in

1 1785.

2 MR. WARNING: Both those documents
3 were within Exhibit 15 which I have.

4 MR. LOHMAR: All right. Why don't
5 you find this one previously marked?

6 MR. WARNING: Did you say 1719?

7 MR. LOHMAR: Yes.

8 MR. WARNING: And 1758?

9 MR. LOHMAR: Right.

10 MR. WARNING: Mr. Papageorge, those
11 are the exhibits that had been marked previously
12 in your deposition.

13 MR. DAVIDSON: That's page 1785.

14 Q. Sir, I've asked the court reporter to show you a
15 document marked NVF 001758 which I believe
16 you've previously testified is a Monsanto
17 document, is it not?

18 A. Yes, sir.

19 MR. DAVIDSON: It's a part of?

20 MR. LOHMAR: I believe it was shown
21 to the witness as a group exhibit.

22 MR. WARNING: It's part of Exhibit
23 No. 15.

24 MR. LOHMAR: Specifically, sir, I've
25 called your attention to a chart that appears on

1 page NVF 001785 which refers to friction losses
2 in system piping?

3 A. I do.

4 Q. Can you explain that chart for the record?

5 A. I'll try. Across the bottom of the page is the
6 designation and the flow rate in gallons per
7 minute. This is the amount of fluid flowing
8 through the system. And the vertical left-hand
9 side, the vertical column talks about a head
10 loss. Now, the head loss is really an
11 expression to describe the amount of pressure
12 behind that liquid, if it's dribbling out the
13 end of the pipeline or has it really got a jet
14 of fluid. The five slanting columns across the
15 page reflect the change in flow rate. Actually,
16 the flow rate does increase as you go from the
17 bottom of the five sloping lines to the top.
18 Each of those sloping lines represents the size
19 of the pipe and its wall thickness. The
20 schedule refers to thick pipe and thin pipe.
21 What this says is that as you increase the flow
22 through each of these size pipes you will note
23 that you lose pressure. The sloping goes on up
24 and you'll lose pressure as measured across the
25 page to this left-hand vertical column called

1 head loss. So what this is really saying is
2 that the faster the flow and the smaller the
3 pipe, the higher the loss.

4 Q. Loss of what?

5 A. Of the pressure.

6 Q. So this chart essentially refers to friction
7 losses due to pressure?

8 A. By friction loss you're talking about a loss of
9 pressure due to the friction of the fluid
10 flowing in that system.

11 Q. If Aroclor 1248 is used in a closed system, is
12 there any reason to have to replace that Aroclor
13 over time?

14 A. There could be many reasons.

15 Q. What would be some of those reasons?

16 A. They could range from contamination from other
17 fluids in the system or there is even a
18 possibility of overheating.

19 Q. How would overheating require the Aroclor to be
20 replaced?

21 A. You can reach the point where you get what
22 amounts to a charring, you're changing its
23 chemistry. We don't know why it changes, but we
24 know it converts from a clear baby oil looking
25 fluid to a dark brown like the oil in your

1 automobile, so something is changing that. And
2 many times that's due to overheating. There are
3 other possibilities where within the system,
4 parts of the system are failing like a gasket is
5 wearing or a packing around the pump or even the
6 metal parts that are moving are losing bits and
7 pieces of metal into the fluid. That would
8 require a change. There are some systems that
9 install filters for this just like the filter in
10 your automobile, but eventually depending on the
11 seriousness of this change you may have to
12 change the whole system out. Moisture can get
13 in when the system is shut down, cools off, it
14 picks up air with some moisture in it, air, you
15 do get some moisture in there that is not
16 wanted. If that moisture is there for a period
17 of time you can get the eventual rusting,
18 creating sources of rust and when you start up
19 the system that rust is moved along with the
20 Aroclor. I'm sure I haven't covered all
21 possibilities, but --

22 Q. How would charring of the Aroclors operating at
23 a higher temperature, how would that impact the
24 integrity of the Aroclor?

25 A. It won't impact -- by integrity you mean

1 changing its chemical composition or its
2 usefulness.

3 Q. Let me rephrase it. Why would one need to
4 replace the Aroclors in a certain system if that
5 Aroclor had charred?

6 A. Charring would result in a deposit of this
7 carbonaceous material at the point of high
8 temperature contact which is expected to be near
9 the source of the heat. In other words, your
10 gas or oil flame, the jet hitting that surface,
11 that carbonaceous matter eventually will sluff
12 off and get into the stream. That affects the
13 effectiveness of the heat transfer back at the
14 using point, not at the heating point, so you
15 find that it's a self defeating process. You
16 raise the temperature because you can't do the
17 hot job at the working end creating more
18 charring or destruction and the system gets so
19 fouled up you have to shut it down and drain it
20 and not only drain it but with this kind of
21 charring you almost have to scour out the
22 innards or replace the tubing and piping that's
23 been coated too heavily.

24 Q. Sir, besides the charring effect that you have
25 just testified to, do you know of any other

1 manner by which a system containing Aroclor 1248
2 would change its color from, as you testified, a
3 baby oil like color to the darker brown color?

4 A. Well, this could occur if some contaminant got
5 in it.

6 Q. Well, let's assume you're dealing with a closed
7 system. In a closed system environment where,
8 excluding the charring effect which you have
9 just testified, can you think of any other
10 manner by which the baby oil like color of
11 Aroclor 1248 would darken into a browner color?

12 A. You could have an entry into the Aroclor portion
13 of the system from the material you're cooking,
14 for example, a varnish that you're heating in a
15 big pot leaks into the jacket and blends in with
16 the material, the Aroclor that's intended to
17 heat it, so you could get that reverse flow,
18 especially with systems that go up and down,
19 you're operating or you're cooling off, so
20 that's what I meant by a contamination from the
21 process itself.

22 Q. Sir, taking another look at the document you
23 have in front of you, the one that begins with
24 Bates NVF 001719 and take a look at the pages I
25 would like to call your attention to NVF 1723,

1 to 1724, which are identified as the physical
2 properties.

3 A. I have them.

4 Q. Sir, taking a look at these physical properties,
5 can you identify for the record at what point
6 one would expect to see some charring of Aroclor
7 1248 and the point, I'm referring to the
8 temperature?

9 A. There is no specific reference to a temperature
10 that one could associate with the charring
11 effect. The closest we can come to, from these
12 sheets is on 1724, where it talks -- where it
13 refers to distillation range, if you exceed that
14 upper range.

15 Q. Talking about the 725 degree Fahrenheit range?

16 A. If you exceed that you start entering a
17 temperature zone that could result in charring.
18 And the higher that excessive temperature
19 becomes, the faster the charring occurs, so it's
20 a matter not only of temperature but time at
21 that temperature.

22 Q. Sir, is there any evaporation effect that may
23 take place to Aroclor 1248 if it's contained in
24 a closed system?

25 A. Depends on the temperature.

1 Q. How does it depend on the temperature, sir?

2 A. If you reach these temperatures of 725 we talked
3 about, you would have a stream of vapors pouring
4 out of there, and that's a form of evaporation.

5 Q. But there is an evaporation loss associated with
6 the use of Aroclor, is there not?

7 A. At room temperature just sitting in the barrel?

8 Q. Let's talk about something higher than room
9 temperature.

10 A. Yes, there is a loss if the system isn't
11 perfectly sealed.

12 Q. In a perfectly sealed system there should be no
13 loss of Aroclors unless you exceed the
14 temperatures we've been talking about so far of
15 700 degrees or so?

16 A. You can lose vapors at the lower range of these
17 temperatures.

18 Q. How would you do that in a closed system?

19 A. If it isn't vented properly so it breathes, if
20 there is no cooling system to condense those
21 vapors, bring them back down into the tank,
22 those vapors can escape the system. So it's a
23 matter of design.

24 Q. Sir, did Monsanto recommend to its customers
25 that those customers perform some type of

1 periodic checkup of the heat transfer systems?

2 A. Yes.

3 Q. Why would Monsanto make that recommendation if
4 you were dealing with a closed system?

5 A. It just falls into the category of a well run
6 unit. And you asked me why Monsanto would be
7 interested, they're interested in, I'm going to
8 call them a satisfied customer, and if the
9 customer's system isn't designed in a way that
10 gives them the expected good service, he may
11 stop using Monsanto's product and go to the
12 competition. So that's all part of the total
13 picture.

14 Q. During these periodic checkups, would the actual
15 color of the 1248 Aroclor be an indication that
16 the Aroclor should be changed?

17 A. It depends on the density of that color and the
18 time in use. If it starts turning yellowish the
19 second week in operation, you got a serious
20 problem. But if it's kind of amber colored 10
21 years in service, that's good service. So a
22 judgment call is required here.

23 Q. Sir, during these periodic checkup
24 recommendations, did Monsanto also recommend to
25 its customers they check the viscosity of the

1 Aroclors?

2 A. Occasionally, yes.

3 Q. Why would that need to be checked?

4 A. That characteristic is another good indicator.

5 Color is one of them and viscosity, if it starts
6 to change, that indicates that you're doing
7 something to that system that is not really
8 proper. For example, your viscosity may go up
9 because you're losing the lighter vapors leaving
10 the heavy vapors behind, and if that continues
11 you're going to end up with molasses in January
12 in your system and you wouldn't be able to pump
13 anything, especially when it's allowed to cool
14 down and you try to start it up again.

15 Q. So viscosity essentially refers to the thickness
16 of the fluid?

17 A. The fluidity.

18 Q. Fair enough. Monsanto -- strike that. Would
19 Monsanto ever offer to check the viscosity of
20 Aroclor fluids as a service it would provide its
21 customers?

22 A. Offers were made on a case by case basis. It
23 was not a blanket kind of advertised service.

24 Q. Let me see if I can refresh your memory, sir.

25 Do you have in front of you NVF 001758?

1 A. Yes.

2 Q. Please turn to the page Bates numbered NVF
3 001779.

4 A. I have it.

5 Q. Taking a look at the very last sentence that
6 appears on -- strike that -- the very last
7 paragraph -- taking the last paragraph that
8 appears in the far right-hand column, see where
9 it says, customers can have their fluid tested
10 by Monsanto free of charge?

11 A. Yes.

12 Q. Does that refresh your memory as to whether
13 Monsanto provided that service to its customers?

14 A. I didn't say it didn't provide it.

15 Q. Let me phrase that as to whether Monsanto
16 offered to its customers to provide that service
17 free of charge?

18 A. Yes, in fact we would supply sample bottles for
19 them.

20 Q. Do you know whether Monsanto ever kept a record
21 of the lab tests it did on customers' Aroclor?

22 A. All samples that were tested were recorded.
23 Records were kept. I don't know how long they
24 kept them.

25 Q. That was going to be my next question. Sir,

1 turning to the same page, left-hand column, at
2 the very bottom says, precautions in cold
3 weather. Do you see that, sir?

4 A. Yes.

5 Q. Why was it that this particular general
6 recommendation was being made to Monsanto
7 customers?

8 A. Primarily because of the fluidity of the PCBs at
9 these low temperatures, 50 degrees and lower,
10 they just don't pump as well and your pump may
11 be working but the fluid isn't moving as rapidly
12 as it should, and as it goes through the now
13 heated chamber, it could get charred the way we
14 spoke about earlier and damaged, so you get a
15 better service if your fluid flows through
16 freely and this is why they recommended keep it
17 warm so it doesn't get so viscous that only the
18 inner part of the stream is flowing and the
19 outer part is up against that hot steel surface.

20 Q. So I understand, sir, how could the fluid inside
21 a closed system char faster if the system was
22 left on in an ambient temperature below 50
23 degrees?

24 A. Because when you turn up the heat -- you've got
25 to visualize a pipe with fluid in it, the fluid

1 along the pipe walls is not moving as fast as
2 the core. That material on the pipe walls is
3 being exposed to this high temperature now and
4 with time, again, it's time and temperature, you
5 could damage the fluid.

6 Q. Would that damage also reflect itself in a
7 discoloration or a darkening of the fluid
8 itself?

9 A. Yes, eventually.

10 Q. Sir, during your first day of testimony, correct
11 me if I'm wrong, you testified when Monsanto
12 recognized there was an environmental problem,
13 potential environmental problem associated with
14 its Aroclors, it offered to take back the
15 Aroclors that some of its customers were using,
16 did it not?

17 A. To some of its customer yes, sir.

18 Q. And it made that offer to the customers that
19 were using Aroclors, for example, 1248?

20 A. Some of them, yes.

21 Q. Did it make it to all of its customers?

22 A. Not in my recollection, not in a blanket
23 informational type correspondence. I don't
24 recall any such offer.

25 Q. To what customers would Monsanto make such an

1 offer?

2 A. That depended on the field marketing team. When
3 they had discussions it was up to the marketing
4 representative to make that suggestion or offer
5 to go back to the bosses and get approval. That
6 kind of dialogue did take place.

7 Q. Was there a record maintained of which customers
8 were contacted and extended the offer to take
9 back the Aroclor that Monsanto sold to it?

10 A. Not to my knowledge.

11 Q. Just a few final questions, I believe, sir. You
12 testified that the environmental problems that
13 Monsanto first recognized in the late '60s and
14 early '70s manifested themselves because PCBs
15 were found in areas where you would not expect
16 to find PCBs?

17 MR. KLINE: Object to
18 characterization.

19 A. I did.

20 Q. Was there ever a time when Monsanto did not
21 expect to find PCBs in a situation where PCBs
22 were being discharged into a stream?

23 A. No, they expected in those situations where the
24 PCBs were allowed to enter a stream they would
25 be found near that source. That was no

1 surprise.

2 Q. So the surprise was when PCBs were found in
3 situations where one would never anticipate PCBs
4 to be found?

5 A. Correct.

6 Q. But in a situation where PCBs were being
7 discharged into a stream, Monsanto would
8 anticipate finding PCBs?

9 A. Yes.

10 Q. Assuming, sir, once Monsanto realized that the
11 PCBs were a potential environmental hazard, how
12 would Monsanto eliminate the PCBs, how would
13 they be destroyed or remediated?

14 A. Remediation?

15 Q. Sure.

16 A. That varied so much from situation to situation,
17 it depended really on ease of access,
18 distribution, the local condition had a lot to
19 do with retrieving that PCBs, putting it in a
20 safer place. I don't know we ever had a
21 standard remediation program.

22 Q. Well, I believe you testified during your first
23 day, sir, that one thing you were recommending
24 once Monsanto realized there was environmental
25 concern out there was that its customers no

1 longer hose these PCBs down the sewer?

2 A. Correct.

3 Q. That is because the sanitary sewer system could
4 not remediate the PCBs?

5 A. That's one reason.

6 Q. What would be the other reasons?

7 A. Some of these sewer systems didn't go through a
8 sanitary system and they ended up in public
9 waterways and places where industrial chemicals,
10 including the PCBs, all industrial chemicals are
11 not perceived by Monsanto to be -- they
12 shouldn't be there.

13 Q. Redirecting a discharge of PCBs from going into
14 a storm sewer that immediately went into the
15 environment to going into a sanitary sewer
16 system, would that have alleviated Monsanto's
17 environmental concerns about the PCBs?

18 A. No, sir.

19 MR. LOHMAR: That's all.

20 MS. SITARSKI: I have no questions.

21

22 EXAMINATION

23 QUESTIONS BY MS. DOUGHERTY:

24 Q. Mr. Papageorge, my name is Ann Dougherty
25 representing Liberty Mutual Insurance Company,

1 one of the defendants in this case. I would
2 like to follow up on something Mr. Lohmar just
3 asked you about and that was the discharge of
4 PCBs to waterways and streams. There is a
5 portion of exhibit, Exhibit No. 3, which is
6 Bates numbered NVF 39 and NVF 40. If you could
7 take a look at this document, and specifically
8 on the first paragraph read the first paragraph
9 on the second page.

10 A. I recall that paragraph.

11 Q. Okay. The last sentence in that paragraph
12 says: "As mentioned in the article," referring
13 to an October 29, 1969, article, "good
14 manufacturing practice in the future may require
15 that no products used by any company be lost or
16 discharged in such a manner as to ultimately be
17 found in waterways." Do you see that?

18 A. I do.

19 Q. I just wanted to see if you can tell us if that
20 was your understanding as of 1969, this letter
21 is dated February 19, 1970, if that was also
22 your understanding at that time?

23 A. Yes.

24 Q. Did you have an understanding prior to 1970 or
25 1969 that it was also not good business

1 practice, good manufacturing practice to have
2 PCBs discharged into waterways?

3 A. Well, when you restrict it to PCBs I find it
4 hard to answer. First of all, we never talked
5 about PCBs, these were Aroclors at Monsanto; and
6 secondly, it wasn't -- in our thinking, it was
7 all industrial chemicals, not any specific type.

8 Q. Can you assign a date prior to 1969 when
9 Monsanto Company would have this feeling or
10 understanding about the products?

11 A. I can only share with you I joined Monsanto in
12 1951 and that was the orientation I got when I
13 joined it, so I don't know when it really began.

14 Q. And I think you've already -- I have no more
15 questions. Thank you.

16

17 EXAMINATION

18 QUESTIONS BY MR. HILBER:

19 Q. I have a very few. For the record, my name is
20 Al Hilber. I'm with the firm of Mendes & Mount
21 and we're representing, for ease of reference,
22 London Market Insurers which is the underwriter
23 of Lloyds and other market companies. And I
24 just have a few questions. One of them was with
25 regards to the customer lists, I know you've

1 testified somewhat ad nauseam, but I am just
2 making sure I'm clear. When a customer would
3 purchase products, they would be placed on the
4 customer list for that product?

5 A. Correct.

6 Q. And periodically and depending on the product
7 and the person, I guess, in charge of that
8 product, those lists would be updated or checked
9 to make sure that they had a concise group of
10 individual customers?

11 A. Correct.

12 Q. When they were updated, was it the practice to
13 also keep the old list or was it at that point
14 generally the practice to discard the old list?

15 A. The practice was to discard the old list so
16 there would be no confusion in future
17 correspondence.

18 Q. So as a result of that it becomes very difficult
19 to know what list existed in what particular
20 years?

21 A. That is correct.

22 Q. I may be touching on a topic you already
23 covered. Pydraul F-9, does that contain PCBs?

24 A. Yes, sir.

25 Q. And the Pydraul, as I understood your testimony,

1 was never sold through intermediaries?

2 A. Not to my recollection.

3 Q. So when you sent, or when Monsanto sent out
4 materials concerning, I guess, some of the
5 environmental concerns that had been raised with
6 regard to PCBs in certain of their products,
7 that would have gone to the customers that
8 purchased Pydraul?

9 A. Within the past three to five years back.

10 Q. And it could have been further back depending on
11 how recently the list has been updated; correct?

12 A. Based on the judgment of the individual
13 responsible for that list, he may include a
14 customer who hadn't purchased any Pydraul for a
15 while based on his knowledge of the system and
16 the reason for the lack of purchases, so
17 sometimes they would retain a customer who
18 hadn't bought anything for five years and other
19 times the customer's name would disappear. But
20 for the three-year period it's definite.

21 Q. With respect to two different -- I know there is
22 a number of questions, specifically Aroclor 1248
23 and 1254, just to speed this up, correct me if
24 I'm wrong, the main difference there is what's
25 indicated by the numbers is there is a greater

1 percentage of chlorine in the 1254 than there is
2 in the 1248?

3 A. That is correct.

4 Q. But these are still very similar materials in
5 terms of chemical composition and makeup?

6 A. Yes, similar in that they belong to the same
7 chemical family but the 1254 mixture had PCBs in
8 it that had more chlorines attached to the
9 carbons than the 1248 mixture did, although
10 there was some overlap. As you look at that
11 wave that the instrument produces, the 1254
12 would have the peaks and valleys more to the
13 higher chlorinated than the 48, but in the
14 middle there was an overlap of the two.

15 Q. Correct me if I'm wrong, you're talking about
16 the graphs and those are the spectrophotometric,
17 the analysis equipment?

18 A. Yes.

19 Q. So they're very similar to one another in terms
20 of -- in other words, you put a sample in one of
21 those instruments and try and detect what
22 chemical is present in that material, the
23 readings for 1248 and 1254 will be very similar?

24 A. Well, similar in some respects, yet there is a
25 difference. So the analyst will make a judgment

1 call as to what he's going to call that
2 analytical result, is he going to say it's
3 Aroclor 1248 or is it Aroclor 1254? And two
4 chemists working at the same laboratory could
5 come up with two different answers in terms of
6 which of the Aroclors is it because it's fuzzy,
7 it's not a real perfect virgin print, so to
8 speak; it's been altered.

9 Q. That's what I wanted to follow up on. And that
10 was my understanding as well, because one has a
11 detect for 1254, there isn't a complete
12 certainty as to whether it is 1254, it may
13 actually be 1248 or vice versa?

14 A. It may have started out as Aroclor 1248 and
15 deteriorated or changed in the environment so
16 now the analyst sees something that looks more
17 like 54 than it did 48.

18 Q. As I understood your testimony earlier today,
19 generally that's how it would go would be from a
20 lower chlorine percentage to a higher one and
21 not from a higher to a lower?

22 A. That is correct.

23 Q. In terms of the properties, you touched upon
24 that, two questions to look for there. 54 is
25 less viscous than 48?

1 A. It's the other way around. The higher the
2 chlorine the more viscous the material.

3 Q. I said it backwards. I actually meant that. Do
4 you know of instances where the two materials
5 were both utilized within a heat transfer
6 system?

7 MR. DAVIDSON: At the same time?

8 Q. Yeah, in other words, maybe to clear my
9 question, perhaps for a while the system has
10 been utilizing 1248 and in a subsequent shipment
11 or some drums came of 54, not necessarily total
12 discharging or emptying the system but adding
13 five gallons, whatever?

14 A. Topping off so to speak?

15 Q. Exactly?

16 A. That can happen. There was a heat transfer
17 product Monsanto sold that was a blend of two of
18 them and my memory is a little bit hazy. One of
19 the Therminols was a blend but I've forgotten
20 which of the Aroclors were blended in what
21 ratios, how much of each.

22 Q. Last question: In other words, the system can
23 operate, to your knowledge, a heat transfer
24 system potentially with both materials. It's
25 not like, I realize some of the operating

1 properties may be a little bit off the specs
2 that Monsanto sent, but you could run a system
3 on having some 1248 in it and also some 1254?

4 A. Some systems would function okay, yes.

5 MR. HILBER: No further questions.

6
7 EXAMINATION

8 QUESTIONS BY MR. KLINE:

9 Q. Mr. Papageorge, my name is Paul Kline. I
10 represent NVF Company in this case and as you
11 know, I'm the caboose. I will be the last
12 person asking you questions in this phase of
13 your deposition and as I understand it there
14 will be a video deposition sometime after that.
15 Let's begin with just some general questions
16 regarding uses of Aroclors by industry. Now,
17 let's talk about plasticizer uses.

18 A. All right.

19 Q. First of all, when did Monsanto first begin
20 marketing Aroclors for use as plasticizers?

21 A. I don't know the exact date, but it had to be
22 after World War II, so it's the late '40s, early
23 '50s.

24 Q. And did those Aroclors that were marketed for
25 use as plasticizers contain PCBs at that time?

1 A. Yes.

2 Q. Now, I'm going to ask you about a specific use
3 and let's see if you've ever heard of the
4 plasticizer use in the capacity. Have you ever
5 heard of mixing Aroclors with phenolic resins to
6 make circuit boards or any laminates, for that
7 matter?

8 A. I've heard of that use, yes.

9 Q. Have you heard of that use beyond anybody other
10 than NVF -- NVF's use?

11 A. I don't know that I associate my knowledge of
12 that use with any specific user. It's the
13 general reference to circuit boards or a
14 phenolic laminate, that broad type of
15 description. I do not associate it with any
16 specific entity by a corporate name or anything
17 like that.

18 Q. Let's see if we can somehow quantify the amount
19 of that use that you recall. Was that what you
20 would call a fairly substantial use based on
21 your recollection or a very minor use?

22 A. I could share with you an impression that I have
23 and it's not based on my analysis of numbers and
24 comparing it to other materials, but it was
25 considered by Monsanto as a modest but

1 respectable amount of material.

2 Q. And you've seen the numbers of the quantities
3 sold to NVF or to American Mineral Spirits
4 Company produced in documents 1 through 38;
5 correct?

6 A. Yes, sir.

7 Q. Would you consider that usage alone a modest or
8 respectable figure for Monsanto?

9 A. I have a difficult time relating it. To
10 Monsanto, it was a very small use. But to your
11 guy, I can't evaluate that with your NVF
12 activities in any way to express an opinion
13 about is it modest or is it -- I just don't have
14 a way to measure it.

15 Q. Let me rephrase the question. If that sales to
16 American Mineral Spirits or National Vulcanized
17 Fiber was the only use of plasticizers for
18 phenolic laminate sold by Monsanto, would
19 Monsanto consider those sales a modest but
20 respectable use?

21 MR. LOHMAR: Objection to form.

22 MR. WARNING: I'll object to the
23 extent you're asking him to speculate.

24 A. Knowing Monsanto, I would suggest that they
25 would probably drop any effort to expand that

1 business. It wouldn't be worth the activity
2 involved.

3 Q. So it's fair to say that NVF Company's purchases
4 of plasticizer Aroclors was very small in the
5 scheme of Monsanto sales?

6 A. That is my opinion, yes, sir.

7 MR. LOHMAR: I object to the form of
8 the question.

9 Q. Would you characterize it as minute?

10 MR. LOHMAR: Same objection.

11 A. Now, we're getting into degrees of smallness and
12 I don't have enough concrete data to put
13 together.

14 Q. Let's then back up a little bit. Are you
15 familiar generally with the quantities of
16 Aroclors sold by Monsanto over the years? And
17 we're speaking obviously in broad generalities
18 here.

19 MR. WARNING: Are you referring to
20 all sales by Monsanto to all customers?

21 MR. KLINE: Correct.

22 A. Yes, sir, I'm familiar, 70 million pounds a
23 year. So when we talk 23,000 pounds, it's a
24 small amount.

25 Q. Of that 70 million pounds, could you very

1 roughly estimate what percentage of that would
2 be plasticizer use sales?

3 MR. LOHMAR: Objection.

4 A. Roughly estimate, I would say half of it.

5 Q. Would it be fair to say that roughly 50 percent
6 of Monsanto's Aroclor business was the
7 plasticizer sales?

8 A. Yes, sir.

9 Q. We've talked about a variety of Aroclors. I
10 think we've mentioned 1242, 1248, 1254, 1260,
11 1268, 5460, 6062, and possibly Aroclors being
12 mixed with other substances such as Pydraul
13 F-9. Is there any reason to think that any of
14 those Aroclors that I just mentioned would be
15 incompatible with a plasticizer use with
16 phenolic laminate which we had just been talking
17 about?

18 A. Incompatible. Well, this compatibility really
19 depends on the end results you're seeking. In
20 some cases you may not want a property that the
21 PCB would offer or end up with whereas in
22 another application that's exactly what I
23 wanted. So I really can't answer that unless I
24 know specifically how much of the PCBs, which
25 one into what and what's the end result being

1 sought.

2 Q. Well, fair enough. Let me try to be a little
3 more specific. Your first day of testimony I
4 believe you indicated that it would be
5 incompatible to put Aroclor 1260 as a heat
6 transfer fluid because it's a solid. Was that
7 your testimony?

8 A. I believe I said Aroclor 1268 which is, it's a
9 solid material and it was sold and looked like
10 coarse table salt.

11 Q. And so it would be fair to say that would be
12 incompatible with a heat transfer fluid
13 application?

14 A. Correct.

15 Q. And that's the incompatibility that I'm trying
16 to get to when I ask you whether any of the
17 Aroclors that I had mentioned earlier would have
18 been incompatible with a phenolic laminate
19 plasticizer use.

20 MR. WARNING: At this point I'm going
21 to object to your line of questioning as not
22 having a proper foundation.

23 A. Well, it's my understanding that with phenolics
24 any of the PCBs can be eventually blended and
25 incorporated. We use the example of the solid

1 Aroclor 1268. That can be heated to the point
2 where it becomes a liquid and incorporated in a
3 product which when it cools down, solidifies and
4 you've got the property you sought whether it be
5 fire resistance or what have you. So in the
6 plasticize application it's much more complex
7 than the heat transfer where you're pumping a
8 liquid, circulating just like the coolant in
9 your automobile.

10 Q. Let me follow up then and ask you a further
11 question. Is there anything that you're
12 familiar with with the properties of the PCB
13 Aroclors that I had mentioned by isomer
14 previously that would cause them to react with
15 phenol in such a way as to create a
16 manufacturing incompatibility?

17 A. I'm not aware of any chemical reaction that
18 would occur under those conditions.

19 Q. The isomers of Aroclors that I had listed, do
20 you know whether each of those particular
21 isomers were used as a plasticizer by any
22 customers of Monsanto?

23 A. Can you help me with your use of the isomers?
24 Isomers means a group of products, all of them
25 having the same chemical content but a different

1 configuration, like you can have a
2 monochlorobiphenyl, you can have ten of those.
3 So when you say isomers that's what that
4 describes. I think what you're talking about is
5 commercial mixtures of various isomers with
6 three and four.

7 MR. LOHMAR: Different types of
8 Aroclor.

9 Q. I stand corrected because you've worked with
10 this more closely than myself. Are there
11 different isomers of Aroclor 1248?

12 A. Aroclor 1248 is in itself a mixture; it is not a
13 pure chemical. It contains many
14 monochlorobiphenyls, several dichloros, many
15 trichloros, tetrachloros, pentachloros, on up
16 and they're present in a really consistent
17 pattern when it's manufactured and all of those
18 chlorines that are arranged with carbon in these
19 mono, di, and tri configurations add up to 40
20 percent of the total mass. I don't know how
21 else to describe it.

22 Q. I appreciate your explanation, and now I'm going
23 to ask you to help me find a better term for
24 what I'm asking.

25 MR. LOHMAR: Perhaps I could help. I

1 think you're referring to Aroclors by that name
2 as opposed to types of Aroclor and isomers of
3 Aroclors. If you ask the question using the
4 term Aroclor, I think you'll get the answer
5 you're seeking.

6 Q. How should I refer to the different numbered
7 Aroclors? Are they different types of Aroclors,
8 different mixtures of Aroclors?

9 A. The Aroclor designation Monsanto used to
10 describe PCB mixtures always had the one-two
11 designation followed by another two digits which
12 represented the amount of total chlorine
13 present. So when you say 1248, that's one-two
14 is a PCB, because there were other Aroclors that
15 Monsanto had that were not PCBs, and the 48 says
16 48 percent of that material by weight when you
17 weigh it is chlorine. Now in that mixture the
18 chlorine is tied to the carbons over a spectrum
19 of one to about six chlorines per PCB molecule.
20 It can have one or it can have six. That one
21 can fit on any of ten positions, some of which
22 are mirror image. It's getting too complex, I
23 think. But anyway, the best way to describe
24 these is to do what the world has really done,
25 refer to them as Aroclor by a number.

1 Q. And that's exactly what I'll do. So let me
2 rephrase my question by taking the word "isomer"
3 out and just say, is there any reason -- scratch
4 that. Do you know whether the different number
5 Aroclors that I had listed at the beginning of
6 this question were used as plasticizers?

7 A. Yes.

8 Q. Were each of those used as plasticizers?

9 A. All of the --

10 MR. LOHMAR: Objection.

11 A. All of the Aroclors Monsanto made that were PCBs
12 found some use as plasticizers somewhere.

13 Q. Before we move onto another topic, let's talk
14 generally again what were some of the bigger
15 plasticizer uses of Aroclors that you're aware
16 of.

17 MR. WARNING: Object to the use of
18 the word "bigger."

19 Q. More substantial purchases of Aroclors for use
20 as plasticizers, what applications did they
21 have?

22 A. I don't pretend to recall the numbers; I'm left
23 with impressions. The big use, as an additive
24 to chlorinated rubber. It was an additive to --
25 they were an additive to adhesives, some

1 adhesives that were active at room temperature
2 and some that had to be heated, the hot melt
3 adhesives. Some of the Aroclors were used in
4 inks, printing inks, colored inks. There was a
5 use in paints, predominantly the traffic lane
6 paints that we used to see, the white and yellow
7 paint on the highways. A very large use was in
8 the carbonless copy paper. It's a part of the
9 fluid, I think, inside the capsule that was
10 ruptured as you wrote across the page. It was
11 used as an ingredient in sealants and caulking,
12 the caulking around the skyscrapers of the
13 world, the World Center towers and all where the
14 PCB would add this property of never drying out,
15 but staying flexible and waterproof and so on,
16 so that's a big use. I'm sure I missed
17 something.

18 Q. I would expect you would have.

19 A. But these are kinds of examples.

20 Q. From the top of your head. Okay. Are any of
21 those uses, and I could go through them because
22 I did list them, what you would consider easy
23 entry uses as you used that term during the
24 first day of your testimony, easy entry into the
25 environment? The first one you mentioned was

1 additive to chlorinated rubber?

2 A. Yes, all of the uses we just described in which
3 Monsanto used the word "plasticizer use," which
4 really meant miscellaneous, in other words, the
5 PCB was used in another ingredient, were
6 perceived to be the type that the minute they're
7 used they're out there in the environment.
8 There is nothing to prevent them from escaping
9 if they're damaged or removed or disposed of.

10 Q. Now, let's switch gears to electrical
11 transformers and the use of Aroclors in
12 electrical transformers. Did Monsanto begin
13 marketing Aroclors for use in electrical
14 transformers approximately the same time as the
15 use as plasticizers which would be the late
16 1940s, early 1950s?

17 A. The use of PCBs as transformer fluids was
18 started in 1929 by the Swan Chemical Company
19 which was purchased by Monsanto. And Monsanto
20 continued the marketing of PCBs to the customers
21 then that started with Swan Chemical Company.

22 Q. Which types of Aroclors were used in electrical
23 transformers?

24 A. Aroclor 1242, Aroclor 1254 and Aroclor 1260.

25 Q. Would Aroclors used in electrical transformers

1 periodically need to be changed?

2 A. Yes.

3 Q. First let's talk about how periodically, or
4 would it depend upon the application and the
5 equipment?

6 A. It would depend on the application as described
7 by the stress that the transformer had to
8 undergo. Was it hit by lightening often, did it
9 arc internally? In other words, its performance
10 and years of performance would affect the
11 quality of the liquid in that unit.

12 Q. Are there any other reasons that you're aware of
13 for the need to change the Aroclors in
14 electrical transformers?

15 A. There is, of course, always the problem of
16 moisture probably collecting in there. That's
17 all that comes to mind at present.

18 Q. Electrical transformers used to power
19 manufacturing facilities, would Aroclors used in
20 those electrical transformers periodically need
21 to be changed?

22 A. Yes, generally.

23 Q. How often generally would that occur?

24 A. That varies so much from maybe every year to
25 every five years.

1 Q. That's all I have with electrical transformers.
2 Let's move on to heat transfer fluids. Again,
3 when did Monsanto begin marketing heat transfer
4 fluids containing Aroclors?

5 A. Again, this is after World War II, about late
6 1940s, early 1950.

7 Q. Before I get into the specifics, can you tell me
8 generally some of the major uses of Aroclors in
9 heat transfer as heat transfer fluids?

10 A. Major uses?

11 MR. LOHMAR: Objection. You can
12 answer.

13 A. Heat transfer systems in automobile tire
14 factories. There were so many different kinds
15 of uses I can't categorize them as a group in
16 terms of type of service. There were so many
17 industrial applications requiring high
18 temperatures, and the owners of these systems
19 were in a position of trying to avoid having
20 licensed steam boiler operators on duty around
21 the clock which a steam system would have
22 required to get the higher temperature, so they
23 went to these PCB type heat transfer systems.
24 There were food uses. By food uses I'm
25 referring to such things as cooking oils that

1 are used to, say, fry potato chips, fry chicken
2 and fish, those kinds of things. I'm having a
3 hard time remembering. There must be hundreds
4 of uses. They just don't come to mind now.

5 Q. That's understandable. Have you ever heard of
6 the use of Aroclors as a heat transfer fluid in
7 industrial presses?

8 A. I associate PCBs with presses, but I don't
9 specifically recall the need for heat, but I
10 just don't remember.

11 Q. Well, let me try to refresh your memory. I'll
12 give you at least one, and maybe that will
13 help. A situation where phenolic, a silicone
14 laminate is pressed, and for it to become a
15 useful product, heat must be applied during the
16 pressing operation in order to create the
17 product. Does that --

18 A. That does. I was thinking of metal presses for
19 sheet metal, automobile fenders and the like.
20 Yes, now I do recall there are materials that
21 must be heated so that you can form them with
22 other pieces of equipment, yes.

23 Q. Now, that use of Aroclors as a heat transfer
24 fluid in industrial presses, would you consider
25 that as well a modest but respectable use?

1 MR. WARNING: Objection. You're not
2 talking about volume, vagueness.

3 A. I have a difficult time answering because I have
4 nothing to compare. I just, the numbers I was
5 looking at in the past were -- just would refer
6 to Monsanto's heat transfer fluids of so many
7 pounds. I don't recall any incident to try to
8 break it out as to what type of uses these were,
9 so I have no way to evaluate it.

10 Q. As far as you know, was NVF one of a number of
11 companies using Aroclors as a heat transfer
12 fluid in an industrial presses?

13 MR. LOHMAR: Objection, lack of
14 foundation.

15 A. Yes, it was.

16 Q. What would be your approximation of how many
17 users there were of Aroclors as a heat transfer
18 fluids in industrial pressing operations?

19 A. Industrial pressing, I don't know.

20 Q. Can you say more than 50?

21 MR. DAVIDSON: More than one?

22 A. I just don't know. Your guess is as good as
23 mine.

24 Q. Well, was there more than one?

25 MR. LOHMAR: Objection.

1 A. I would be speculating. I would say yes,
2 because that's my understanding of the business
3 of the industrial world out there, but I have no
4 other basis than that.

5 Q. Do you know whether there were design
6 consultants within the United States that were
7 solicited by various industries to design
8 Aroclor heat transfer systems for their
9 operations?

10 A. Yes.

11 Q. Did Monsanto have a relationship at all with
12 those design consultants? For example, did
13 Monsanto send those design consultants technical
14 bulletins?

15 A. Yes.

16 Q. Did Monsanto have a technical staff at its own
17 plants or offices or facilities that would be
18 able to make a recommendation as to who to speak
19 with in the -- as far as design consultants in
20 order to construct a heat transfer type system?

21 A. Well, Monsanto never did get into the business
22 of acting as an engineering consulting company.
23 All that Monsanto could do was describe its
24 products and what it knew about its products in
25 terms of chemical and physical properties. And

1 it would also be willing to share with others
2 its experiences with its equipment under its
3 conditions, which may or may not help the person
4 seeking information of that kind. If a design
5 consultant would contact Monsanto, Monsanto
6 would work closely with him in terms of
7 supplying him product literature, sharing
8 experiences, cautioning against the fact that if
9 you use this kind of material you're going to
10 get this kind of effect. If you use the wrong
11 gasket, it's going to fail on you in a few
12 weeks, we've gone through that kind of sharing.
13 Monsanto never did, to my knowledge, publish a
14 list of recommended or approved design engineers
15 or consultants, never did go that far.

16 Q. When creating various technical bulletins such
17 as the bulletin marked 1719, was it Monsanto's
18 -- was it Monsanto's expectation that the end
19 user of that system would be the party
20 constructing that Aroclor heat transfer system
21 or was that product bulletin designed to some
22 extent for design consultants or designers?
23 That is a terrible question. Strike it, shoot
24 it outside, let me start over.

25 MR. LOHMAR: I won't ask for it to be

1 read back.

2 Q. When Monsanto was piecing together technical
3 bulletins such as document NVF No. 1719, was it
4 Monsanto's expectation that the ultimate user
5 would be using that technical bulletin directly
6 in all cases?

7 A. That's one ultimate use, yes.

8 Q. Would it also be expected that that would be
9 used by a design consultant for constructing a
10 heat transfer system?

11 A. Yes, sir.

12 Q. Did some heat transfer uses -- strike that.
13 Let's switch gears a little bit onto situations
14 where Aroclors in heat transfer systems needed
15 to be changed. We had talked about that a
16 little earlier when Mr. Lohmar had asked you
17 some questions. First of all, just as
18 generalities, would it be fair to say that a
19 need to change Aroclors in a system depended
20 upon, first of all, the particular application?

21 A. Well, yes. When you say particular application,
22 are you referring to the designed application or
23 to a problem with an application that wasn't
24 anticipated?

25 Q. I would be thinking more or less the difference

1 between use for cooking potato chips versus use
2 in an industrial press, would the need to change
3 depend upon the different applications?

4 A. Not necessarily. It depends on the
5 temperatures, the design of the system, the
6 rates of circulation, types of venting that are
7 used, so it isn't the fact that you have potato
8 chips versus this press you talked about, it's
9 how is it all put together and what's expected
10 of it.

11 Q. And how it's being used?

12 A. Well, yes. Did you overheat it, for example, or
13 did you do something else that affected the
14 liquid that's circulating inside.

15 Q. Okay. Let's talk about a few different
16 situations that might affect the useful life
17 span of Aroclors in heat transfer fluid in a
18 heat transfer system. And you let me know
19 whether you agree those particular factors might
20 affect useful life. You indicated first
21 temperature. Now, do you know what temperatures
22 were the maximum recommended temperatures for
23 Aroclors in a heat transfer system?

24 A. I don't remember off the top of my head now,
25 no. But there were limits. This is why there

1 were several types of Monsanto's Therminols
2 available depending on the temperature you
3 wished to achieve.

4 Q. What would happen when the temperature would be
5 exceeded?

6 A. The chances were good that the surface through
7 which the heat from the oil or gas flame would
8 be transferred to the fluid inside, whether it
9 be a jacket or a pipe, a coil, whatever the
10 system, if the liquid itself gets overheated,
11 that implies strongly that some of it got very
12 overheated, especially that right up against
13 that hot wall. Under those conditions, you can
14 get this charring we spoke of earlier. It
15 carbonizes, it becomes like road tar or even
16 harder than just a tarring material, it becomes
17 gritty and cakes on that surface and cokes; it
18 forms a coke. That's what I meant by
19 overheating. The material is then stressed and
20 it loses some of its good properties and picks
21 up undesirable properties.

22 Q. Okay. Does the term dehydrohalogenate mean
23 anything to you?

24 A. Dehydrohalogenate?

25 MR. LOHMAR: Objection.

1 A. I'm not familiar with that particular
2 terminology, but I think I understand what
3 they're trying to describe. That's in essence
4 what happens when you end up with coke instead
5 of a fluid, this charring coking effect. It's
6 lost the chlorine and hydrogen and ends up with
7 coke, black stuff on the surface.

8 Q. Would Aroclors have a boiling point?

9 A. Oh, yes. That's what the distillation range
10 is. You boil it, condense the vapors to make
11 the product.

12 Q. Would this charring that you're talking about
13 occur before the boiling point is reached?

14 A. No, it's a temperature that exceeds its boiling
15 point.

16 Q. Now, when the boiling point is reached, the
17 Aroclors will begin to vaporize?

18 A. Correct.

19 Q. Now, in a system that has an expansion tank will
20 those vapors escape?

21 MR. LOHMAR: Objection.

22 A. It depends on the design of the tank system.
23 Does it have a means of condensing those vapors
24 and returning them back into the system or is it
25 a system where it will trap the vapors until a

1 certain pressure is reached, and then it will
2 release them like a safety valve so you don't
3 blow up the system with too much pressure. Once
4 that relief valve releases the vapors, they
5 escape out into the air.

6 Q. Could there be a heat transfer system designed
7 without some type of release for vapors of
8 Aroclors?

9 MR. LOHMAR: Objection.

10 A. You could design it, but I wouldn't call that
11 responsible designing. You always have to
12 provide a relief feature in the event you create
13 a lot of vapor pressure and the system can't
14 tolerate it, you've got to release it; otherwise
15 the tank will explode.

16 Q. Now, when vapors are released, do you have an
17 understanding of whether they dissipate locally
18 or whether they're carried off in the
19 environment to any distance?

20 MR. LOHMAR: Objection.

21 A. That depends an awful lot on the environment
22 this equipment is in, is it outdoors, is it
23 enclosed in a building --

24 Q. Let me interject it is outdoors -- it's
25 outdoors, the boiler mechanism is outdoors,

1 would Aroclors have a tendency to condense
2 locally and deposit locally or do they have a
3 tendency to migrate great distances?

4 MR. LOHMAR: Objection.

5 Q. Any distances?

6 MR. LOHMAR: Still under the same
7 objection.

8 MR. KLINE: Doug, I'm allowed -- what
9 is the basis of your objection?

10 MR. LOHMAR: I think you're asking
11 him to speculate. I think you're asking very
12 broad questions about heat transfer systems as
13 opposed to asking questions about a specific
14 heat transfer system, and I think when you're
15 dealing with the dispersion of a certain vapor,
16 it's only common sense that's going to depend on
17 the amount of vapor being discharged, the length
18 of distance between the vapor discharged and the
19 ground and the volume of vapor discharge at any
20 one given time. I object that it's overly
21 broad.

22 MR. WARNING: I'll object to the use
23 of the term "locally." I'm not sure there is an
24 understanding about what that is.

25 Q. Let me rephrase the question. Do you have an

1 understanding of whether vaporized Aroclors in
2 the outdoor environment have a tendency to
3 condense locally or whether they migrate?

4 A. That depends on --

5 MR. LOHMAR: Same objection.

6 A. That depends how much wind is blowing through
7 the facility. Assuming no wind at all, the
8 tendency for PCB vapors would be, since they're
9 heavy, to condense and descend right over the
10 unit. But that happens so seldom, there is at
11 least some lateral movement. The distance that
12 lateral movement will cover depends an awful lot
13 on how much vapor is up there in the air, how
14 high did it reach, and what wind currents
15 carried it and how far and fast did that wind
16 move before the droplets settled.

17 Q. One nugget in your response is actually what I
18 was getting at and let me focus on that. You
19 indicated that Aroclors and PCBs are heavy;
20 therefore, they have a tendency to deposit
21 locally. Is that your understanding, omitting
22 the effect of wind?

23 A. That's true.

24 Q. Now, is it your understanding that heat transfer
25 systems were at times pressurized and at times

1 unpressurized?

2 MR. LOHMAR: Objection.

3 Q. Let me rephrase the question. Are all heat
4 transfer systems pressurized according to your
5 understanding?

6 MR. LOHMAR: Objection. Talking
7 about ones using Aroclor?

8 MR. KLINE: Yes.

9 Q. Are heat transfer systems that use Aroclors
10 pressurized systems?

11 A. They are pressurized because of the existence of
12 a pump to circulate the cooler fluid through the
13 heating unit back to the point of use, so the
14 pump is what provides the pressure.

15 Q. But when the pump is not operating, is the
16 system at atmospheric pressure?

17 A. Well, it's at a constant pressure depending how
18 tight it is and whether the atmosphere can
19 influence it.

20 Q. Do you have any understanding of the pressures
21 that are created by pumps connected to Aroclor
22 heat transfer systems?

23 MR. LOHMAR: Objection.

24 A. In the case of understanding of those charts we
25 saw earlier with the friction loss depicted and

1 the rate of flow, the pump pressure and so on.
2 So I think that's a good chart to get an
3 understanding.

4 Q. Have you ever heard of artificially pressurizing
5 a heat transfer system with, say, nitrogen?

6 A. I have not.

7 Q. Have you ever heard of pressurizing a heat
8 transfer system apart from the pressure created
9 by a pump?

10 A. I have not.

11 Q. Let's assume a heat transfer system that's
12 operating well below the boiling point of the
13 Aroclors contained within, let's say 400 degrees
14 Fahrenheit. If there was a leak in that system,
15 at a joint, or a connection, some type of pipe
16 leak, what would that leak -- how would that
17 leak manifest itself, in a liquid, a gas or
18 something else?

19 MR. LOHMAR: Objection, call for
20 speculation.

21 MR. KLINE: If you know.

22 A. Generally a leak in an active working heat
23 transfer system will manifest itself by, of
24 course it depends on the size of the leak, if
25 it's a little drip, you see the oil and maybe a

1 wisp of vapor off it. If it's a stream that
2 squirts that fluid clear across the room, you're
3 going to see vapors coming off that stream and
4 liquid falling onto the floor or on the wall.
5 And as long as it's hot, you will see some
6 evidence of vapors. Does that help?

7 Q. It does. Would the amount of vapors increase as
8 the temperature increases, therefore, if you
9 reached close to the boiling point would you
10 expect to find more vapor?

11 A. Yes.

12 MR. KLINE: Off the record.

13 (Discussion off the record)

14 MR. KLINE: Back on the record.

15 Q. Reading through one of the technical bulletins
16 for use of Aroclors as a heat transfer fluid, I
17 noticed a recommendation of a filter at
18 temperatures above 600 degrees Fahrenheit. Do
19 you have any understanding of why that would be?

20 A. This relates to this carbonizing we talked about
21 earlier and the presence of particulate matter
22 now in the fluid and the filter serves to remove
23 it from the fluid, just as the filter in your
24 car removes solids from the oil that's
25 circulating through your car engine. The same

1 principle. It's to keep the system clean so the
2 fluid performs better and does not deposit more
3 and more of this material back where the
4 transferring is taking place.

5 Q. I'm going to make an analogy that I understand
6 which is an automobile and the car filter. I
7 know when I change my car filter in my
8 automobile, I have to drain the fluid first or I
9 will lose it all. Is that the same case for
10 heat transfer systems?

11 MR. LOHMAR: Objection.

12 A. It depends on how it's designed. Some systems
13 are designed where you can isolate the filter
14 system by shutting off and having a loop around
15 it, take out the filter, put in a new filter and
16 reopen. So it depends really on the design. If
17 it isn't designed to make replacement that easy,
18 you're really -- what they do is try to get as
19 much of that fluid in the holding tank and what
20 little is still left in the pipeline is drained
21 into a container. The filter is changed and the
22 material that was collected is reintroduced into
23 the holding tank, the vent tank.

24 MR. LOHMAR: Off the record a second.

25 (Lunch recess.)

1 MR. KLINE: Back on the record.

2 Q. Before lunch we concluded talking about how
3 temperature could affect the need to change
4 Aroclors in heat transfer fluid systems. Let's
5 talk quickly now about -- let's discuss now how
6 water contamination or moisture, first of all,
7 how it could get into a heat transfer system if
8 you know.

9 A. Well, of course, one way is when the system is
10 shut down and cooling, you get this effect of
11 reduction in vapor volume and the system is
12 sucking in air and the air does contain some
13 moisture. Of course, that moisture finds its
14 way into the system and depending, again, on how
15 long the system is idle and how long this
16 moisture has time to react with the steel
17 surfaces and all, you get iron rust forming
18 which can pose some problems eventually if this
19 is repeated often enough. A little bit doesn't
20 hurt but it's possible to reach a point where it
21 does become a problem. So that's one way
22 moisture gets into a system. Another is a
23 situation where there is some moisture in the
24 process which is being served by this heating
25 element, and if there is a failure between the

1 metal surfaces separating the heating fluid from
2 the material being processed, moisture can enter
3 from the reverse direction. Again, this would
4 more normally happen when the system is idle for
5 some reason whether it's being worked on or
6 whether it's not needed any longer for the rest
7 of the period. That's the only suggestions that
8 come to mind at the present.

9 Q. How is it that the moisture affects the
10 usefulness of the Aroclors?

11 A. Well, primarily because it forms this iron rust
12 that I talked about, which is a -- in small
13 quantities doesn't really introduce any serious
14 problems other than a discoloration. But if you
15 get enough of it and if the system is a complex
16 design with sharp turns and corners, it
17 accumulates and these accumulating spots become
18 hot spots and they could cause some problems in
19 the way your unit is working. And it doesn't
20 perform efficiently any longer and sometimes it
21 requires shutting down and cleaning them out,
22 not only on the Aroclor side but also on the
23 process side.

24 Q. If Aroclors became so infiltrated by moisture as
25 to reduce the ability for a machine to reach

1 temperature that were necessary would you need
2 to change those Aroclors or somehow purify them?

3 A. If it's reached the point where moisture is
4 affecting the ability of the PCBs to reach the
5 desired temperature, that would indicate an
6 awful lot of moisture because a little bit of
7 moisture can be driven off. A higher level
8 could create some problems in terms of driving
9 off that moisture to get steam pressure building
10 up, really, and it does affect performance. At
11 that point one can say open up the system and
12 just keep heating the Aroclors until they dry
13 out, which would create vapors in the
14 environment because the moisture is leaving
15 along with some PCB vapors. Unless you have a
16 condensing system, and then the condensing
17 system could also condense the water and bring
18 it back into the system, so it defeats the
19 purpose of this drying effect. Generally if
20 moisture does become a problem, it's best to buy
21 a fresh supply, drain the system entirely, dry
22 it out as much as you can. You may need a
23 solvent between the drain and the refill, and by
24 solvent, it should be something that isn't, of
25 course, explosive but at the same time will

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1 dissolve oily materials, something like maybe a
2 heavy kerosene, if carefully handled could do
3 the job.

4 Q. When you're talking about a solvent are you
5 talking about somehow flushing the system before
6 refilling the system?

7 A. I am, yes.

8 Q. Now, would it be true that the more often a
9 system is shut down, so to speak, the more
10 potential there would be for the infiltration of
11 moisture and the problems we talked about?

12 A. Yes.

13 Q. Would the fact that a boiler, and by boiler I'm
14 referring to the mechanism that heats the
15 Aroclors, would the fact that a boiler is
16 located out of doors, subject to a temperate
17 climate, temperature fluctuations from zero
18 Fahrenheit to 100 degrees Fahrenheit and the
19 fact that a system is shut on and off on a
20 regular basis, would that have any effect on the
21 useful life of the Aroclors?

22 A. I hear two questions; one is the fact that it's
23 located outdoors, does it affect, and the fact
24 that it's on and off does it affect.

25 Q. Right.

1 A. The fact that it's outdoors should not affect.
2 In fact, that's the preferred location. This is
3 why you have heat transfer systems, to get the
4 source of ignition like gas and oil remote from
5 the use point so you don't have fires and
6 explosions. The fact that it's on and off
7 frequently is very apt to cause this breathing
8 phenomenon within the system sucking in moist
9 air, creating moisture problems, or when it's
10 breathing outwards releasing PCB type vapors,
11 which is undesirable as well.

12 Q. By undesirable you mean you would lose the fluid
13 from the system and have to replace it?

14 A. That's one undesirable feature, it's an economic
15 wasteful practice. The other one is the
16 introduction of an undesirable material in the
17 environment out the vent.

18 Q. In the 1960s was it considered undesirable to
19 have vapors from the Aroclors being released
20 into the environment?

21 MR. WARNING: Objection, undesirable
22 by whom?

23 MR. KLINE: I'm just using his own
24 term.

25 MR. WARNING: I'm still wondering,

1 are you asking from Monsanto's perspective, from
2 the witness' perspective individually?

3 MR. KLINE: From, I mean the witness
4 is here as Monsanto's designee, so I would be
5 asking him in his capacity as corporate
6 designee.

7 MR. WARNING: You're asking as
8 Monsanto.

9 MR. KLINE: As Monsanto.

10 MR. LOHMAR: I'm going to object. I
11 find the term environment vague.

12 A. Monsanto always perceived the release of any
13 vapors of a chemical nature to be just not
14 desirable by high standards of industrial
15 performance really, and at that point in time it
16 was not perceived to be an environmental issue
17 based on the knowledge available at the time.

18 Q. But at the same time those systems which you
19 said optimally the boiler would be located
20 outside were designed so as to enable vapors to
21 escape if necessary?

22 A. If necessary, yes, sir.

23 Q. And it would be necessary to prevent, as you had
24 said, an explosion?

25 A. That's one reason, yes.

1 Q. Would the type of material used to construct a
2 heat transfer system, and by that I'm referring
3 to the piping in particular, would that affect
4 in any way the useful life of the liquids
5 flowing through that system?

6 MR. LOHMAR: Could I have the
7 question read back, please?

8 (Question read.)

9 A. When you said heat transfer system, I'm assuming
10 you're using the full system from heat input to
11 use of that heat.

12 Q. You may assume that, yes.

13 A. When it comes to introducing heat into the
14 Aroclor, it really makes no difference whether
15 it's stainless steel or copper or plain old
16 steel, but over in the end use it depends on
17 what is it you're heating and does it react with
18 steel or with copper or with stainless steel.
19 So you have to make a selection of the material
20 dependent on what it will be exposed to
21 primarily at the heating end -- yeah, the heat
22 is used, not where the heat it inputted or
23 introduced.

24 Q. Did Aroclors need to be used soon after delivery
25 or did they have a long shelf life?

1 A. They last forever.

2 MR. LOHMAR: As well we know.

3 Q. Now, we've been talking about the heat transfer
4 system use of Aroclors. Was that a type use
5 that Monsanto considered an easy entry use as
6 you had referred to earlier?

7 A. It was not categorized as such.

8 Q. Now, let's switch gears to air compressors. Let
9 me ask you, are you familiar with Aroclors being
10 used in air compressors at any time?

11 A. Yes, sir.

12 Q. In what way would they be used in air
13 compressors? What purpose did they serve?

14 A. It's primarily a lubricant to help the
15 compressor function smoothly without binding,
16 without overheating, and the Aroclor itself
17 would not be such that if overheating does
18 occur, it doesn't ignite. So you have this
19 flame resistance feature that is considered to
20 be a good feature for this use.

21 Q. Do you know whether any particular types of
22 Aroclors were best suited for use in air
23 compressors?

24 A. As I recall, it's the 1242 and 1248.

25 Q. Let's switch gears to my last subject matter

1 concerning the industrial uses of Aroclors, and
2 that is as hydraulic fluids. Now, when we refer
3 to the use of Aroclors as hydraulic fluids, are
4 we suggesting that the Aroclors are mixed with
5 water which itself is the hydraulic fluid?

6 MR. LOHMAR: Objection.

7 A. I'm not aware of any use where water and PCBs or
8 Aroclors are blended. They don't blend. The
9 PCBs sink to the bottom and water floats. That
10 would not be a typical mixture.

11 Q. Let me give you an example and ask you whether
12 this would be atypical as well. A hydraulic
13 press is operated by a water -- a pressurized
14 water hydraulic system where there is a ram
15 underneath a press which pushes the what we call
16 the platens together to press material. Now,
17 can you think of a use of a hydraulic fluid
18 Aroclor to be mixed with that pressurized water
19 system?

20 A. I'm not aware of any reason for doing it that
21 way.

22 Q. Switching gears, we're going to talk about --
23 pardon?

24 MR. LOHMAR: Or fluids as the case
25 may be. Go on.

1 Q. We're going to talk a little bit about sales of
2 Aroclors. Again generally, as I had begun my
3 questioning, did the sales of Aroclors from the
4 time they were introduced till the time they
5 were discontinued in the very early 1970s, did
6 sales grow in any predictable pattern?

7 MR. LOHMAR: Objection. Are you
8 talking about any particular Aroclor or Aroclors
9 in general?

10 MR. KLINE: Aroclors in general.

11 A. Would you help me with the word "predictable"?
12 By whose predictions?

13 Q. Let me try to be clear. Just ask the first
14 question which is did the sales of Aroclors grow
15 from the time they were first introduced to the
16 time they were discontinued?

17 A. Yes.

18 Q. Now, was there a yearly percentage increase in
19 growth that was expected or reported by
20 Monsanto?

21 MR. LOHMAR: Objection.

22 A. The sales of PCB type products did increase
23 yearly. I'm not aware of what expectations
24 there might have existed through the years. I'm
25 led to believe from all I can gather that the

1 business was a promising business. It was not a
2 major product line, but it was a respectable
3 business that blended well with other businesses
4 Monsanto had with many of the same customers.
5 So if you sell customer A product B and he also
6 buys Aroclors, great. So there was an
7 interaction. But nevertheless, the sale of PCBs
8 did climb at a steady rate rather reflecting the
9 general growth in the economy of the nation. It
10 didn't shoot up unexpectedly, it was a steady
11 gradual growth.

12 Q. Would you say that steady gradual growth
13 continued through the 1960s?

14 A. Yes.

15 Q. Did sales of Aroclors taper off to any extent
16 immediately prior to Monsanto sending notice in
17 early 1970 if you know?

18 A. I don't recall any tapering off. I just don't
19 believe it did.

20 Q. The first notice concerning the environment that
21 you testified to, as far as I understand, was
22 the 1969 notice to big users; is that correct?

23 A. That was the first written formal notification.

24 Q. Would you consider NVF to be one of those big
25 customers?

1 A. No.

2 Q. Did, if you know, did sales taper off
3 immediately after that notice being sent?

4 A. No.

5 Q. By letter dated June 1, 1970, if you can picture
6 that, Monsanto stated it would discontinue the
7 manufacture and sale of PCB containing Aroclors
8 as of August 30, 1970; is that your
9 understanding?

10 A. Yes, sir.

11 Q. In that three-month window, do you know whether
12 the sales of Aroclors were affected?

13 A. The sale of the Aroclors in these immediate
14 release type applications jumped a bit, but I've
15 forgotten what percentage increase. There was
16 an increase where the customers were, in
17 essence, stockpiling for the future so they
18 could buy some time to find replacements. And
19 our notice in June with only two months' time,
20 didn't give them enough time to go doing any
21 searching or looking for alternatives so they
22 bought inventories to tide them over until they
23 could find the alternatives.

24 Q. Now, as of this date of August 30, 1970, is it
25 the case that Aroclor sales by Monsanto ceased

1 entirely at that point?

2 A. The sales to the majority of those easy release
3 uses stopped on the 30th. There just wasn't
4 another pound shipped. The only exception was
5 the carbonless copy paper where the makers of
6 that paper just did not have an alternative and
7 they would have had to completely shut down. So
8 they received PCBs until they found an
9 alternative, which was about six months later.

10 Q. By letter dated December 31, 1971, Monsanto
11 stated that it would discontinue the manufacture
12 and sale of PCT containing Aroclors as of March
13 31, 1972; do you recall that?

14 A. Yes, I do.

15 Q. Again, within that three-month window, do you
16 recall whether the volume of PCT containing
17 Aroclors was affected?

18 A. Not noticeably.

19 Q. But sales occurred at the same rate, then, as
20 prior to that notice?

21 A. Correct.

22 Q. Now, at the date of March 31, 1972, would that
23 be a date where the sale of PCT containing
24 Aroclors ceased entirely?

25 A. Yes.

1 Q. Now, were PCB containing Aroclors sold to the
2 government?

3 A. Yes.

4 Q. Where there any standards setting organizations
5 which used Aroclors as a standardized product
6 for a particular industrial manufacturing use?

7 A. I'm not aware of the use of the word "standard"
8 as it would apply to Aroclors in any
9 application. There were criteria established,
10 for example, by the Underwriters Laboratories,
11 Factory Mutual regarding flash points, explosion
12 limits, and the like. But PCBs were not
13 mentioned as specifics that would meet those
14 standards.

15 Q. What's Factory Mutual?

16 A. Well, I understood this was an insurance related
17 activity running a laboratory in which they
18 conducted tests, standard tests for evaluating
19 proposed materials, equipment and the like.

20 Q. And is it your testimony that they would have
21 been running tests on Aroclors as well?

22 A. They did run some tests regarding Aroclors and
23 their fire resistance.

24 Q. Was their testing expected to be shared with the
25 insurance industry?

1 MR. LOHMAR: Objection, move to
2 strike.

3 A. That I don't know.

4 MR. WARNING: I'll object. There is
5 absolutely no foundation that he has any
6 knowledge of that area. That's outside the
7 scope of this subpoena.

8 MR. LOHMAR: I also have no idea what
9 you mean by the insurance industry.

10 MR. KLINE: I withdraw the question.

11 Q. Were PCT containing Aroclors discontinued by
12 Monsanto because they were being detected in the
13 environment or because there were alternatives
14 that didn't contain PCT?

15 A. PCTs were not detected in the environment.
16 There were alternative materials available to
17 perform reasonably well for the uses that the
18 PCTs were involved in and Monsanto decided to
19 discontinue the availability of a chlorine
20 containing hydrocarbon which the PCTs were,
21 based on their experience with the PCBs. And
22 they decided as long as there is an alternative
23 material, let's get out of this business.

24 Q. Asking you to take a look again at what had
25 previously been marked as exhibit -- let's go

1 off the record.

2 (Discussion off the record)

3 MR. KLINE: Back on the record.

4 Q. Placing in front of you what's been previously
5 marked as Exhibit 3, ask you first to take a
6 look at document No. 41, 42.

7 A. I have scanned the two pages mentioned.

8 Q. That document refers to an attached letter to
9 all Aroclor customers that Monsanto was
10 intending to send around February 27; correct?

11 A. It does.

12 MR. LOHMAR: Could you repeat that
13 question, please?

14 Q. That letter which is NVF 41 --

15 MR. LOHMAR: I would like to have the
16 court reporter read it. I would like the court
17 reporter to repeat it unless you're asking it
18 again.

19 (Question read)

20 A. I didn't realize I was asked a question.

21 Q. Mr. Papageorge, is that document that is said to
22 be attached the document that is numbered NVF 44
23 and 45?

24 A. It is.

25 Q. Now, turning to 44, the last paragraph beginning

1 two states: PCBs with a chlorine content of
2 less than 54 percent have not been found in the
3 environment and appear to present no potential
4 problem to the environment. Do you see that?

5 A. I do.

6 Q. And yet we know that the sale of Aroclor 1248,
7 which is an Aroclor with a chlorine content of
8 less than 54 percent was discontinued in August
9 of 1970; correct?

10 A. Correct.

11 Q. Was Aroclor 1248 found in the environment prior
12 to its discontinuance or was it that an
13 alternative existed to 1248, being the PCT
14 containing Aroclors?

15 A. 1248, as of these dates we talked about, had not
16 been identified in environmental samples. The
17 fact that there were some alternative materials
18 available for the uses that were discontinued
19 August 30 of 1970, helped lead to the decision
20 to discontinue all PCBs irrespective of whether
21 the analyst was seeing it in samples or not.

22 Q. Do you know when, if at all, Monsanto determined
23 that Aroclor 1248 was being found in the
24 environment?

25 A. By the end of 1970, our laboratories at Monsanto

1 and others, the government labs and the like,
2 had found evidence of the other PCBs, including
3 1248, in samples taken near industrial sites,
4 near the possible sources. They had also begun
5 to arrive at the understanding that what could
6 start out as a 1248 is now being seen by an
7 analytical chemist as 54 and that's what we were
8 reporting early on in the 1968, '69 period. So
9 the inference was developing that this 1254 that
10 was being reported could well have started out
11 as these other Aroclors. But rather than wait
12 for the definite proofs to come in, which would
13 take years, decided to stop selling to those
14 open uses to avoid any possibility that that is
15 really the source.

16 Q. I understood your testimony to say that at the
17 end of the 1970s there was knowledge being
18 gained by Monsanto that 1248 was being found in
19 the environment; is that correct?

20 A. There were a few samples taken from Monsanto
21 plants and a few of the other customer plants
22 that used the 1242 and 1248, and those samples
23 taken near that plant from the soil or from the
24 rain wash outs and so on from the plant site, so
25 that showed that the 42 and 48 percent materials

1 could be out there. But they may not be in the
2 pine trees in Sweden, but they're next door kind
3 of conclusion was being reached.

4 MR. DAVIDSON: What was the time
5 period you stated?

6 MR. KLINE: Off the record.

7 (Discussion off the record)

8 MR. KLINE: Back on the record.

9 Q. The time period that I was interested in is when
10 Monsanto is becoming aware that Aroclor 1248 was
11 being found in the environment after --

12 MR. DAVIDSON: In your predicate to
13 your last question I thought you said something
14 different than what he said.

15 MR. WARNING: So did I.

16 MR. DAVIDSON: You said late '70s;
17 that's not what he said.

18 MR. WARNING: I thought you said, Mr.
19 Papageorge, it was late 1970, the year 1970.

20 A. You said '70s; I meant 1970.

21 MR. WARNING: You meant the year, not
22 the decade?

23 THE WITNESS: Correct.

24 Q. (By Mr. Kline) So turning back to 44 where the
25 statement is made to a customer that PCBs with a

1 chlorine content of less than 54 percent have
2 not been found in the environment and appear to
3 present no potential problem to the environment,
4 at least at the February 19, 1970, date, it is
5 true that Aroclor 1248 was not known by Monsanto
6 to be found in the environment?

7 A. That is true.

8 Q. And is it your testimony that later in that year
9 Monsanto was becoming aware that 1248 could be
10 persistent in the environment because it could
11 have been biodegrading into 1254?

12 A. That was the understanding that was evolving
13 from the limited samples they had by the end of
14 that year, 1970.

15 Q. Was that knowledge that we just talked about
16 communicated by notice to Monsanto customers?

17 A. Not by written notice. It was relayed by the
18 marketing people in their contacts, whether it
19 be by phone and by personal visits in their
20 update of the environmental issue, that was the
21 major piece of information that was transmitted
22 as best I remember, October through December of
23 '70.

24 Q. Did those marketing people speak with the
25 ultimate users, even though those users

1 purchased through an indirect customer of
2 Monsanto such as American Mineral Spirits
3 Company?

4 A. The intent was that they would speak to all of
5 the customers assigned to them. Now, I cannot
6 speak specifically for American Mineral Spirits
7 and its customers. It was up to the field man
8 to decide with American Mineral Spirits who's
9 going to talk to who. They may have divided the
10 workload or American Mineral Spirits may have
11 said, we will handle all of these and went to
12 it.

13 Q. So is it your testimony that there was an effort
14 by Monsanto to provide notice to the end users
15 that Aroclor 1248 was, in fact, also appearing
16 to present a potential problem to the
17 environment?

18 A. For that particular message, but it's just a
19 continuation of the ongoing PCB environmental
20 issue. As part of an update every so many
21 months, this type of communication would take
22 place.

23 Q. Can you say whether Monsanto would have
24 communicated that directly to NVF Company?

25 A. I cannot.

1 Q. Generally, without again going into the specific
2 applications, what -- scratch that question.
3 What products competed with Monsanto's Aroclors
4 used as heat transfer fluids, let's say in the
5 1960s if you know?

6 MR. LOHMAR: Do you include water in
7 that characterization?

8 MR. KLINE: No.

9 MR. LOHMAR: Objection, vague;
10 talking about what commercially available
11 products did they purchase as a substitute for
12 Aroclors?

13 MR. KLINE: Yes.

14 MR. WARNING: I'll object. Again,
15 you're getting off the scope of the subpoena of
16 this deposition.

17 MR. KLINE: I think it's certainly
18 relevant to know what alternative products were
19 available other than Aroclors for this use.

20 MR. WARNING: Again, it's not in the
21 subpoena, but let's move along. I don't want to
22 be here forever.

23 A. Products that were used in heat transfer systems
24 were primarily of mineral oil source. I am not
25 personally aware of any material that is fire

1 resistant that was sold specifically as a heat
2 transfer fluid unless, of course we excluded
3 water, so I just don't remember any material
4 that has this fire resistant characteristic that
5 competed with Monsanto's Aroclors.

6 Q. Now, prior to 1970, did Monsanto work on
7 developing a substitute for Aroclors that did
8 not contain PCBs?

9 A. No.

10 Q. Switching gears again, let's talk about sales to
11 NVF or American Mineral Spirits as an indirect
12 customer of Monsanto who supplied NVF. We
13 looked at a series of summary sheets which was
14 marked as Exhibit 25. I would ask you again to
15 take a look at that document.

16 A. I have it.

17 Q. Now, document 2 which is 00002?

18 A. I have it.

19 Q. Does that indicate a sale of Aroclor to NVF
20 Company?

21 A. This indicates a forecast of five, which
22 apparently was not realized during that year
23 since there is no figure as to what was the --
24 what deliveries were made each month.

25 Q. Is there any indication that there were sales of

1 product to NVF Company from 1964 through and
2 including 1969 on the documents that you have in
3 front of you, Exhibit 25?

4 MR. DAVIDSON: What years?

5 MR. KLINE: '64 through and including
6 '69.

7 MR. LOHMAR: Objection, documents
8 speak for themselves.

9 A. On the document NVF 3, there is a summary for
10 the year 1964 of one of the heat transfer
11 Aroclors, zero pounds with an asterisk, and the
12 asterisk indicates that it was less than 500
13 pounds, the implication being that in that year
14 a delivery was made to an unknown location of
15 NVF of a small amount of material which would
16 imply a topping off of a system.

17 Q. Apart from the sale within the period that I
18 have given you, were there any other sales?

19 A. There are no other sales available from the
20 records.

21 Q. Now, you had talked a little bit about how the
22 records may not be complete.

23 A. That's right, for the years 1954 to 1977.

24 Q. Is there any reason to think that the records
25 would be incomplete after the 1963 time period

1 owing to the fact that there was details given
2 prior to that year?

3 MR. LOHMAR: Objection.

4 A. By the '60s the system in place and the
5 procedure followed was pretty well established
6 as distinguished from what existed in 1950s. So
7 I personally believe the '60s and '70s data more
8 than I did the '50s data as reflecting more
9 accurate information.

10 Q. You testified, I believe, that based upon
11 document 2, which is part of Exhibit 25, NVF
12 Company would have shown up on a Monsanto
13 customer list; is that correct?

14 A. Based on document 2 --

15 Q. Yes.

16 A. -- it would show on a list. Yes, sir, it would
17 normally show on a list active and in use on or
18 about that time period.

19 Q. Now, for purposes of determining when NVF
20 Company would have been dropped from that
21 customer list due to inactivity, on what date
22 should we start counting?

23 MR. LOHMAR: Objection.

24 MR. KLINE: Basis?

25 MR. LOHMAR: Speculation.

1 MR. KLINE: If you know.

2 MR. LOHMAR: Same objection.

3 A. I don't know specifically for NVF, but I can
4 share with you the practice that was normally
5 followed. In most cases generally throughout
6 Monsanto's marketing, when they reviewed their
7 lists, and this varied from product to product
8 and from manager to manager, but when he had the
9 check on this, a review of his customer list, he
10 would certainly pick up those customers that
11 received any amount of material for the three
12 years prior to the review date, three full
13 years. And then he would make every effort to
14 add to that list those who did not purchase but
15 they were aware through their marketing team
16 that there were still systems in use, such as
17 apartment buildings heated with PCBs that don't
18 take much attention and they hadn't purchased
19 anything because they didn't need anything, but
20 the stuff was still there, so they would include
21 that type of customer on that list. So they
22 would pick up about two more years back. And
23 then they would also pick the very exceptional,
24 the type of situation where to them it meant
25 either a very important customer or a customer

1 they may have lost that they hoped to get back
2 again. This was a judgment call on his part.
3 So as a minimum, to summarize, the minimum is
4 three years for sure and any other situations
5 that the manager felt were important to him and
6 his business.

7 Q. Now, for purposes of counting those three plus
8 two years, would we begin on the date reflected
9 on NVF 2 which is part of Exhibit 25 even though
10 there was no sale made on that date or would we
11 go back to the date of the last sale?

12 A. You're talking about, now, say, 1966?

13 Q. Correct.

14 A. An example is your 1966, this manager has a
15 customer list of the product 1254. The fact
16 that NVF Wilmington purchased or didn't purchase
17 anything in 1965, brings it to the forefront in
18 terms of do we add them to our list or not and
19 based on what else he knows about Wilmington and
20 NVF he may or may not have NVF on his list.

21 Q. Is there any reason to think that NVF would be
22 on that list in February of 1970?

23 MR. LOHMAR: Objection.

24 MR. WARNING: Objection.

25 A. Is there any reason?

1 Q. To think that NVF would be on that list in
2 February of 1970?

3 A. I would be very surprised if they were, based on
4 this document.

5 Q. Correct.

6 A. There is other information.

7 MR. LOHMAR: Let the record reflect
8 the witness is holding up as "this document"
9 Bates numbers one and --

10 THE WITNESS: Bates numbers one and
11 two.

12 Q. What other documents would suggest to you that
13 NVF would have been on a customer list, let's
14 say, in February of 1970?

15 A. I'm looking at Exhibit 25, page NVF 21, for
16 example. I see nothing here that would assure
17 me that NVF would be on a customer notification
18 list in 1970 from Monsanto direct.

19 Q. Correct, and I appreciate that clarification.
20 Let's then just switch gears for a moment. Do
21 you recall that in the February, 1970, notice
22 Monsanto requested its indirect customers to
23 provide notice to their customers?

24 A. I do.

25 Q. The letter does not suggest to the indirect

1 customers how far back they're supposed to go in
2 their customer list; correct?

3 A. It does not.

4 Q. Do you know whether Monsanto communicated with
5 their indirect customers concerning how far back
6 they should go and whether that was as far as
7 Monsanto was going?

8 A. We shared with the distributors represented by
9 companies such as American Mineral Spirits our
10 approach and recommended strongly that they do
11 the same thing. And we even composed, as I
12 recall, a sample letter for them.

13 Q. Do you have any knowledge of how American
14 Mineral Spirits Company conducted its own
15 search?

16 A. I have no knowledge other than I was assured it
17 was all done.

18 Q. Do you know whether they -- scratch that. By
19 stating that you were assured that it was all
20 done, is that to say that you were assured that
21 they searched their records as far back as
22 Monsanto was searching its own?

23 A. That was the understanding I was left with.

24 Q. So therefore, if Monsanto -- if there is no
25 reason to think NVF was on a customer list of

1 Monsanto in the 1970s, is there any reason to
2 think that they would be on a customer list of,
3 let's say, American Mineral Spirits at the same
4 time?

5 MR. LOHMAR: Objection, calls for
6 speculation.

7 MR. WARNING: Objection.

8 MS. SITARSKI: Objection, lack of
9 foundation.

10 MR. LOHMAR: Calls for speculation.

11 A. If NVF purchased anything from American Mineral
12 Spirits that contained Monsanto Aroclor in that
13 three to five-year period, I would be very
14 surprised if they didn't get some notification.

15 Q. The records we have from Monsanto indicate no
16 sales of Aroclors in the three to five-year
17 period prior to February of 1970; correct?

18 MR. LOHMAR: Objection.

19 MR. WARNING: Objection.

20 A. The records show no sales from Monsanto to NVF
21 at any of its locations. It does not reflect
22 anything regarding Monsanto to American Mineral
23 Spirits, American Mineral Spirits to NVF. I
24 don't have that information.

25 Q. Let's briefly talk on the subject of technical

1 bulletins and how Monsanto distributed those.
2 Now, did Monsanto use the customer lists or the
3 customer list, I should say, that would have
4 been generated including NVF -- let me strike
5 that question and try to rephrase it. Where a
6 customer was purchasing its product -- strike
7 that, too. Where a user was purchasing Aroclors
8 through one of Monsanto's indirect customers,
9 such as a distributor, American Mineral Spirits,
10 would it be Monsanto's -- would it be Monsanto's
11 procedure to mail the technical bulletins
12 directly to the user bypassing the distributor
13 or would the technical bulletins go to
14 distributors?

15 MR. WARNING: Objection, that's been
16 asked and answered, but go ahead.

17 MR. LOHMAR: Also object to the form
18 of the question. I think you're confusing
19 direct and indirect.

20 MR. KLINE: If you don't understand
21 the question, I'll be happy to rephrase it.

22 A. I understand the question, but if Monsanto did
23 not have the name and address of the potential
24 user, there is no way they could have sent
25 literature. In other words, they're not even

1 aware the discussion is going on out there. If
2 on the other hand they got a telephone call from
3 American Mineral Spirit and they said, hey, we
4 got a customer up here interested and we ran out
5 of bulletins, would you mind sending them, they
6 do that. Or American Mineral Spirits may well
7 have said, send us a collection of those, we ran
8 out and we have to send it to our customers. It
9 may be NVF or ABC Company and so on. So there
10 are many possible ways in which this information
11 could get to that eventual user of Monsanto's
12 products.

13 Q. I guess my question is more, would technical
14 bulletins automatically have been sent to users
15 of Aroclors even though those users purchased
16 through indirect customers such as distributors?

17 A. If Monsanto had their name and address, they
18 would get it.

19 Q. So essentially Monsanto would be sending
20 material directly to a user even though that
21 user was not Monsanto's customer?

22 MR. LOHMAR: Objection, ambiguous.

23 A. That is possible, like I said, if Monsanto had a
24 name and address that says this customer uses
25 our product Aroclor 1248, and a bulletin was

1 just printed revising the old bulletin, that
2 name and address would be on the mailing list.

3 MR. LOHMAR: Are you done with your
4 answer?

5 THE WITNESS: Yes.

6 MR. LOHMAR: Would you please repeat
7 the question?

8 (Question read)

9 MR. LOHMAR: I'm going to object to
10 the question. I know I'm objecting late because
11 Mr. Papageorge did a good job of answering the
12 question. I don't want there to be any
13 confusion. Mr. Papageorge has testified that
14 users, if known to Monsanto, are considered
15 Monsanto's customers. Therefore, I think your
16 phrasing of your question is somewhat
17 ambiguous. Just to clarify, this is a situation
18 where the bill to and ship to are different and
19 Mr. Papageorge has testified again and again
20 that if the billed to and shipped to are
21 different, Monsanto considered them both to be
22 Monsanto customers for the purpose of these
23 mailings.

24 MR. KLINE: Let me rephrase my
25 question.

1 Q. Without American Mineral Spirits asking Monsanto
2 to send a technical bulletin to one of the
3 American Mineral Spirits' customers, would
4 Monsanto automatically ship technical bulletins
5 to that customer of American Mineral Spirits
6 Company?

7 MR. LOHMAR: Objection.

8 A. They wouldn't know that customer was out there
9 interested. Where would they get his name and
10 address?

11 Q. If they had the name and address because, for
12 instance on Exhibit 2 -- Exhibit 25, Page 2,
13 there is an indication of NVF Company,
14 Wilmington, would that, therefore, cause
15 Monsanto automatically to ship that customer a
16 technical bulletin?

17 MR. LOHMAR: Objection, asked and
18 answered.

19 MS. SITARSKI: Objection, asked and
20 answered.

21 A. Yes, this is an example of the ship to bill to,
22 two names, two entities involved with one
23 shipment. In order for Monsanto to be sure it's
24 communicating, it addresses both of those names
25 with a new bulletin that came out on or about

1 the time. The fact that that name appears in
2 1965 does not mean that that same address and
3 name appears on a list that we're looking at in
4 1970. It may or may not have been picked up,
5 but in the year 1965, '66, yes, they would have
6 gotten revisions of a bulletin that relates to
7 that product.

8 Q. And you said may or may not have been picked
9 up. You previously testified that you would
10 have been surprised that Monsanto would be
11 included on that customer list in 1970?

12 MR. LOHMAR: I believe you mean NVF
13 was included.

14 Q. Was included in on that list in 1970?

15 A. Yes, because of the amount of material involved
16 here, it would not have been perceived as a
17 major end user. And the fact that no material
18 was shipped to them for an extended period of
19 time would reinforce the thought that this may
20 not be an appropriate piece of communication.

21 Q. Just so I understand your prior answer, is it
22 your testimony that Monsanto would as a matter
23 of business practice if it had the name of an
24 indirect customer's customer, such as NVF, and
25 the address, that automatically without a

1 request by that indirect customer send technical
2 bulletins to the end user?

3 MR. WARNING: Asked and answered
4 several times. I don't know why you keep doing
5 this, but let's go forward.

6 A. If that shipment and recording of that
7 information occurred within this three-year
8 period I talked about, where you automatically
9 show up on a mailing list, that customer, in
10 this case NVF, would have received any notices,
11 bulletins and the like.

12 Q. So I guess now from listening to your answer, I
13 guess my question really is, for purposes of
14 sending out technical bulletins as distinguished
15 from sending out notices in the early 1970s of
16 PCB contamination or problems with the
17 environment, was the same process used to
18 determine who to ship the material to?

19 MR. WARNING: Objection, asked and
20 answered.

21 A. Ship the material --

22 Q. Ship the notification or technical bulletin to?

23 A. The same process was followed.

24 Q. By looking at 2, one more time which is part of
25 Exhibit 25, by virtue of the entry of NVF

1 Company, Wilmington, is there any indication
2 that that company's mailing address was also
3 known and on record at Monsanto?

4 A. At this point in time?

5 Q. At this point in time?

6 A. Yes.

7 Q. So that was just dropped off on this print?

8 MR. LOHMAR: What was dropped off?

9 MR. KLINE: The address.

10 MR. LOHMAR: Talking about the street
11 address?

12 MR. KLINE: Uh-huh.

13 A. None of them have the specific mailing address.
14 They have a reference and then they have, I
15 think it's an Addressograph code of some sort,
16 the old time recording system where they could
17 go to that number and find the mailing address.

18 Q. Let's talk a little bit more about technical
19 bulletins and which technical bulletins would be
20 sent to which direct customers, indirect
21 customers, end users. Was a conscious effort
22 made on the part of Monsanto to send those
23 technical bulletins that were relevant to the
24 use to which the Aroclors were being put by the
25 direct customer, indirect customer, or user?

1 MS. SITARSKI: Objection, compound,
2 asked and answered, vague.

3 MR. WARNING: Asked and answered.

4 MR. KLINE: Asked and answered by
5 myself?

6 MR. WARNING: My objection is I've
7 asked him those questions and he's answered
8 them.

9 MR. KLINE: The New Jersey rules
10 allow me to ask the questions you've asked. The
11 asked and answered objection doesn't apply to
12 different counsel.

13 MR. LOHMAR: Can you cite that rule?

14 MR. KLINE: Paul Pantino (phonetic)
15 cited it to me in a deposition three months ago.

16 MR. WARNING: So you don't personally
17 know this rule at this time.

18 MR. KLINE: No, I'm relying on Paul
19 Pantino's representation to me.

20 MR. LOHMAR: This is a situation
21 where we have a third-party witness testifying
22 in an out of state deposition and we're now
23 almost at the end of the second day, and we're
24 only asking you, Counsel, to avoid if possible
25 to avoid asking questions that have already been

1 answered. And I don't think this witness has
2 changed his testimony in any way and I think at
3 this point you're over exerting and to a certain
4 extent harassing a third-party witness toward
5 the end of the second day of the deposition.

6 Q. (By Mr. Kline) I apologize. Are you sensing
7 that I'm harassing you, because if you are, I
8 will define --

9 A. I don't sense harassment, sir. I try to answer
10 the question as I understand it and I don't know
11 the legalistic ramifications of all this. I
12 just try to answer questions when I'm supposed
13 to answer them.

14 MR. KLINE: I will move on.

15 MR. DAVIDSON: It is three o'clock.

16 Q. But the pending question, was that one you could
17 answer, because I would like to have an answer
18 to that and move on.

19 A. I could give you my answer if it's appropriate.
20 As I recall the question was was the procedure
21 Monsanto used to send out technical bulletins
22 and literature of all kinds on the products
23 based on the use of the products, as I recall
24 the question.

25 Q. Correct.

1 A. Technical bulletins are initially issued to a
2 known customer, either a direct one or indirect
3 one, known to Monsanto when the interest is
4 exhibited in that product and make certain when
5 they get their first shipment they already have
6 the information in hand. When the information
7 bulletins, product brochures, whatever you want
8 to call them are revised, the latest mailing
9 address is consulted in terms of what product
10 was shipped. So it's product oriented more than
11 use oriented. Now, if there is a bulletin
12 describing use of Aroclors, and many Aroclors
13 are listed, all of the customers of all of those
14 Aroclors get that copy whether they're
15 interested in the full document or just a
16 paragraph in it. That's handled that way. For
17 those situations where we do not know where that
18 shipment went because it went through companies
19 like American Mineral Spirits, we have to rely
20 on American Mineral Spirits. There is no other
21 way we would know. And many times American
22 Mineral Spirits would not share that information
23 with us because they don't want to lose that
24 customer. I think that's the real world, so we
25 have to rely on them. And as I understood it,

1 the product when it's received by American
2 Mineral Spirits is his product. Ownership
3 changes FOB Monsanto shipping dock, as I recall,
4 so it's his product and we try to select
5 distributors that are responsible people and
6 understand these things. And when we issued
7 guidance to them, they in every case that we
8 know of, listened to it, they abided by it. So
9 we did try as best we could to supply the known
10 users of Monsanto's products with the
11 information, with the new information.

12 Q. Information relating to the products that they
13 used or the applications to which they put them?

14 A. Whatever was appropriate.

15 Q. Now, if you recall from the first day of
16 testimony there were several notices in the '70s
17 sent out by different groups or divisions at
18 Monsanto; is that correct?

19 A. That is correct.

20 Q. Would it be fair to say that likewise those
21 notices would have been intended to be sent to
22 the customers or users that were using the
23 particular product related to that group or
24 division or applying a product in a way related
25 to that division's work?

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WATER_PCB-SD0000074526

1 A. Eventually, the end user, the person who has the
2 material on his site or in his product, would
3 get the information.

4 Q. Is there any reason to think that Monsanto --
5 that NVF or American Mineral Spirits Company,
6 let's talk about NVF. Is there any reason to
7 think that assuming that NVF received a
8 notification directly from Monsanto, that they
9 would have received a notification relating to
10 any use other than plasticizer use?

11 MR. LOHMAR: Objection.

12 A. You said assuming they received?

13 Q. Maybe it would be easier if I used a document.
14 Is that question confusing to you?

15 MR. LOHMAR: I think it's confusing.
16 I thought all the letters Mr. Papageorge was
17 shown the first day were created to address
18 certain users of certain products based on the
19 type of Aroclor that that person had been
20 shipped, and not the use to which that person
21 used that Aroclor. In other words, it wasn't as
22 though they shipped it to plasticizers and then
23 they shipped it to paint people, et cetera, they
24 shipped it to 1248 and 1254, etc. That was my
25 understanding, so I think the question is

1 confusing.

2 Q. Let me ask it this way. Do you have any reason
3 to think that any notice other than a notice
4 from Mr. Schalk, director of sales, plasticizers
5 would have been sent to NVF Company?

6 A. I do.

7 MR. LOHMAR: At any time? Could I
8 hear that question back?

9 MR. KLINE: At any time?

10 A. At any time or at this point in time? You
11 mentioned Mr. Schalk. That's early 1970s?

12 Q. Correct.

13 A. In early 1970, I don't have any information that
14 would lead me to believe that they would have
15 received a similar notification because of the
16 use of the Pydraul F-9 because they hadn't
17 purchased Pydraul F-9 since 1963. And that
18 represents a seven-year lapse in time. There is
19 no reason to believe that they would still have
20 been on the Pydraul F-9 mailing list.

21 MR. KLINE: Off the record a second.

22 (Brief recess.)

23 MR. KLINE: Back on the record.

24 Q. Mr. Papageorge, have you had a moment to look
25 over document 18, Page 114, 115, 116?

1 A. As well as 117.

2 Q. 117 is not necessary for my questions.

3 A. Yes, I have.

4 Q. From looking at this document can you determine
5 the use to which NVF was putting its Aroclors
6 that it had purchased?

7 MR. LOHMAR: By this document, you're
8 referring to 114?

9 MR. KLINE: 114, 115, and 116.

10 MR. LOHMAR: I object because I think
11 they're separate documents.

12 MR. KLINE: I suggest that you read
13 the results portion of the memo.

14 A. By reading the limited information here, I am
15 left with an impression that the material is
16 used in one of the products to inhibit
17 flammability.

18 Q. And would that be a plasticizer use as we've
19 been using that term?

20 A. That's a very typical plasticizer use, yes.

21 MR. LOHMAR: I'm going to object to
22 both questions on the grounds documents speak
23 for themselves.

24 Q. Who was it at Monsanto that was responsible for
25 providing notice to plasticizer users --

1 plasticizer Aroclor users?

2 A. Mr. Schalk.

3 Q. Now, to follow up on the prior question which
4 was do you have any reason to think that any
5 notice was received by NVF other than from Mr.
6 Schalk in the plasticizer group, you've already
7 mentioned you had no reason to think Pydraul
8 notice was received. Is there any reason to
9 think any other notice was received?

10 MR. WARNING: Objection.

11 A. The fact that Aroclor 1254 is mentioned in this
12 exhibit coupled with the lack of shipping data
13 from previous exhibits in the period '65 to '77
14 here, implies strongly that they were getting
15 Aroclor 1254 from someone else. The change to
16 Aroclor 6062 was a recent change, by recent I
17 mean in nineteen -- after the discontinuation of
18 PCBs to the open end uses, and that shipment was
19 made direct from Monsanto to NVF, this is how
20 they got on the list and this is how Monsanto
21 field salesmen got involved.

22 Q. First of all, you said that these documents
23 imply they were getting Aroclors from someone
24 else. Is that to say that perhaps their
25 manufacturing operation -- is that to the

1 exclusion of the fact that perhaps their
2 manufacturing operation changed for a period and
3 they had no need for Aroclors?

4 MR. LOHMAR: Objection.

5 Q. Do you know whether -- we should get an answer
6 before I ask the next question.

7 A. I'm a bit confused by the question, but the
8 reference to Aroclor 6062 being an alternative
9 for Aroclor 1254, as a flame resistant
10 ingredient in NVF's product implies that up to
11 that point where 6062 was introduced they were
12 using Aroclor 1254. The absence of any
13 shipments from Monsanto to NVF strongly implies
14 that Aroclor 1254 was obtained from a
15 distributor of Monsanto instead of directly from
16 Monsanto's warehouse, and that Aroclor 1254 was
17 also used as the flame retardant in that same
18 product, same type of product.

19 Q. Are you saying that the sales summaries that
20 we've been looking at in Exhibit 25 are sales
21 not from a distributor to NVF but from Monsanto
22 directly to NVF?

23 A. Correct.

24 Q. Of the technical bulletins that you've looked at
25 during your deposition, do any of them prior to

1 1970 contain any indication of an environmental
2 concern relating to the use of Aroclors?

3 A. They do not.

4 Q. Do any of them recommend a manner of disposal of
5 Aroclors?

6 A. They do not.

7 Q. Was Monsanto performing any type of
8 biodegradation testing on Aroclors at any point
9 before 1968?

10 A. No.

11 Q. And why not?

12 A. There was no known reason for asking the
13 question are they degradable or not. This was
14 not a common test for industrial chemicals, so
15 it would not have been a routine activity.
16 There was just nothing known to raise that kind
17 of question.

18 Q. Would it be fair to say that Monsanto assumed
19 that Aroclors would biodegrade prior to 1968?

20 A. Not necessarily, because Aroclors were perceived
21 to be very stable unreactive chemicals and as a
22 result they were perceived to be so unreactive
23 they were, and we've used the expression many
24 times, like pebbles on the beach. Unless you
25 stub your toe on them, they don't do any harm.

1 They're there.

2 Q. So Monsanto had no reason to think they would
3 cause any harm in the 1960s?

4 A. That is the understanding of the time, yes.

5 Q. When we say Aroclors persist in the environment,
6 could Aroclor 1248 persist in the environment
7 for, say, 40 years?

8 A. Yes, and it depends really on the conditions to
9 which it's exposed.

10 MR. WARNING: I want to go back to
11 your question before this last one. I think,
12 Paul, you said Monsanto didn't know anything
13 about the -- something about -- maybe we should
14 have the court reporter read the question back,
15 something about the effects on the environment
16 in the 1960s, was that what you said?

17 MR. KLINE: Yes.

18 MR. WARNING: I think that
19 mischaracterizes his prior testimony by labeling
20 it the whole decade of the 1960s.

21 Q. Should we carve out any particular years
22 concerning Monsanto's knowledge of PCBs being at
23 all harmful to the environment in the '60s?

24 A. In late '68, '69 there were allegations of a
25 perceived harm. There was more evidence of its

1 presence in the environment as distinguished
2 from the effect on the environment. So even as
3 of late '69 there were some major question marks
4 regarding the effect.

5 Q. Have all those questions been answered today?

6 A. The early allegations that related to the
7 inability of the pelican to reproduce off of
8 southern California and the effect on the
9 peregrine falcon were proven within a year or
10 two to have been due to DDT, not to PCBs. So
11 what was alleged in '68, '69 turned out not to
12 be so about late '70, early '71.

13 Q. But it got you thinking about PCBs?

14 A. It certainly got not only Monsanto but many
15 others.

16 Q. I think you made the comment earlier that it was
17 Monsanto's belief that all discharges of
18 industrial chemicals to the environment even in
19 the 1960s was something to be avoided?

20 A. Yes, I did.

21 Q. Are you talking, when you speak of discharge as
22 to accidental leaks as well?

23 MR. LOHMAR: Objection.

24 MR. WARNING: Objection, overbroad,
25 accidental leaks from what?

1 MR. KLINE: I just want to get a
2 sense of what he means by the term "discharge."

3 Q. Was it that every small leakage was considered
4 something by Monsanto that should be completely
5 avoided or was it the purposeful dumping that
6 was bad?

7 A. Any entry of industrial chemicals into the
8 environment whether by accident, a railroad tank
9 car accident or a burst line at the plant or the
10 hosing down of the floor should be avoided, and
11 when it happens every action should be taken to
12 minimize it, to help correct it immediately.
13 This does not mean we're going to be perfect.
14 Some of it will still get away, but the whole
15 understanding and message that we tried to
16 convey was, don't tolerate it.

17 Q. If something leaks, fix it?

18 A. Fix it or curb it or put some sawdust on the
19 floor and gather it up, put a curb around the
20 leak, put a pan under the dripping pump and so
21 on.

22 Q. That's not to say that the reason to avoid it
23 was because it was known that it would harm the
24 environment?

25 MR. LOHMAR: Objection.

1 A. It doesn't necessarily have to be harm, it just
2 doesn't belong there in the understanding,
3 industrial chemicals don't belong out there in
4 the ditches and rivers and creeks and lakes, on
5 and on.

6 Q. But yet as you testified to earlier industrial
7 chemicals were found both at NVF -- Monsanto's
8 customers' sites and even at Monsanto's own
9 manufacturing facilities?

10 A. Correct, yes.

11 Q. So there were releases that were occurring both
12 at Monsanto and at its customers?

13 A. Everywhere, not only of PCBs but other
14 chemicals. But that doesn't mean it was right.
15 The whole message was minimize, don't abuse.

16 Q. Do you recall the date of the material safety
17 data sheets that you looked at earlier today?

18 A. Yes, I do.

19 Q. What was that?

20 A. Early '72.

21 Q. In Exhibit 25, which includes the sales
22 summaries, could you turn to Page 21 of that
23 exhibit?

24 A. I have it.

25 Q. There is an indication that from 1954 to 1970,

1 zero pounds of Aroclor were shipped -- were
2 shipped to the Kennett Square facilities?

3 MR. LOHMAR: Object, it
4 mischaracterizes the document, mischaracterizes
5 his prior testimony, document speaks for
6 itself. I think it's clear all the document is
7 saying --

8 MR. KLINE: Your interpretation is
9 not necessary, Mr. Lohmar.

10 MR. LOHMAR: It's not necessary to
11 try to confuse this witness by mischaracterizing
12 his testimony. He has never said, nor does the
13 document say that this indicates that no
14 shipments were made. This document speaks for
15 itself, it says no sales found. Please do not
16 try to confuse this witness by mischaracterizing
17 documents, sir.

18 MR. KLINE: I was not trying to
19 confuse the witness. That was just due to the
20 fact of bad questioning.

21 MR. LOHMAR: I'm objecting to try to
22 prevent you from giving him bad questioning at
23 3:40 in the afternoon.

24 Q. Does this document reflect that there were no
25 sales to the Kennett Square facility or no

1 shipment to the Kennett Square facility, if you
2 know?

3 MR. LOHMAR: Same objections.

4 A. This document is telling me there is no record
5 of any sales or shipments of any PCB type
6 products in the years 1954 to 1970. That
7 doesn't say they got it, it doesn't say they
8 didn't get it. The records are not complete.

9 Q. I want to finish just by showing you two
10 documents and simply asking you whether they
11 were prepared by Monsanto in the ordinary course
12 of business, retained in Monsanto's files and
13 produced from Monsanto's files in this
14 litigation. And those two documents begin with
15 the page 3811 and 3839; I'll mark it as Exhibit
16 29.

17 (Documents
18 marked as Exhibit No. 29
19 for identification.)

20 MR. WARNING: I believe 3811 has
21 already been used. Did you say 3811? I think
22 it's already been entered as an exhibit. Let me
23 check. 3811 is Exhibit No. 4. What was the
24 other number?

25 MR. KLINE: 3839.

1 MR. WARNING: That one was not used
2 previously.

3 MR. KLINE: We can still ask the
4 question.

5 Q. Have you reviewed those documents, Mr.
6 Papageorge?

7 A. I have scanned them, yes.

8 Q. And in response to my question -- should I ask
9 the question again?

10 A. I would appreciate it.

11 Q. Sure. Is Exhibit 29 a true and correct copy of
12 documents generated by Monsanto in the ordinary
13 course of their business?

14 A. They are.

15 Q. And were they retained in Monsanto's files?

16 A. Yes.

17 Q. And produced from Monsanto's files for purposes
18 of this litigation?

19 A. Yes.

20 Q. Did you have any involvement in the actual
21 production of documents in this case?

22 A. Yes.

23 Q. Are you aware that there were actually two --

24 MR. DAVIDSON: I think he's
25 misinterpreting your question.

1 Q. Did you physically assist in selecting and
2 providing the documents that we've been using
3 during the deposition?

4 MR. DAVIDSON: To these lawyers?

5 A. Oh, no, I'm sorry. I thought you meant the
6 documents I'm scanning here, was I involved with
7 the documents I'm scanning, the answer is yes.
8 Was I involved with the production of those
9 documents to you, no.

10 Q. Do you understand that there were two
11 productions, the first being documents 1 through
12 117 and the remainder being produced at a
13 separate time?

14 A. I did not understand it that way, no.

15 Q. Last question is, have you prior to your
16 deposition met with counsel for any of the
17 defendants in this case?

18 A. No.

19 Q. Have you had any conversations with them over
20 the telephone?

21 A. No.

22 MR. KLINE: Thank you.

23 MR. WARNING: Anybody else? Mr.
24 Lohmar?

25 MR. LOHMAR: Two minutes of follow-up

1 questions, sir.

2

3

EXAMINATION

4

QUESTIONS BY MR. LOHMAR:

5

Q. If you recall, you have seen a document I
6 believe it's number 112, which indicates that on
7 August 13, 1970, NVF was shipped a certain
8 amount of Aroclor 1254, do you remember that
9 document, sir? If not, I can show it to you.

10

A. I think I remember it. Yes, I remember it.

11

Q. The document in front of you, have I correctly
12 recited what that document says, it shows a
13 shipment, the document 112 which is now in front
14 of you shows a shipment of Aroclor 1254 to NVF
15 on August 13, 1970; does it not?

16

A. It does.

17

Q. After August 13, 1970, would NVF have been added
18 to whatever customer lists Monsanto maintained
19 for customers of Aroclor 1254?

20

A. Yes.

21

Q. And would they have received any documents going
22 to any such customers regarding the effects of
23 Aroclor 1254 on the environment or any other
24 arena?

25

A. Yes.

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1 Q. Would they have received any letters that were
2 postdated August 13, 1970?

3 A. Yes.

4 Q. Would they have received any technical bulletins
5 that were postdated August 13, 1970?

6 A. Yes.

7 Q. Prior to, since as of August 13, 1970, Monsanto
8 was aware, was it not, of certain environmental
9 concerns involving PCBs entering the
10 environment?

11 A. Yes.

12 Q. So what steps would Monsanto have taken to
13 insure that NVF was similarly aware of those
14 environmental concerns prior to actually
15 shipping the shipment indicated on document NVF
16 112?

17 A. Monsanto would have relied on American Mineral
18 Spirits in this case to convey that information.

19 Q. When you say you would rely on American Spirits,
20 someone at Monsanto would actually contact
21 American Spirits?

22 A. Yes, in fact in some of the exhibits, as I
23 remember, there was a letter to a representative
24 from Mineral Spirits to which was attached
25 copies of the kind of information we were

1 sharing with those that we shipped to directly
2 and it recommended that American Mineral Spirits
3 and companies like that do the same thing.
4 That's what we relied on.

5 MR. LOHMAR: That's all I have.

6 MR. WARNING: I have one follow-up
7 question.
8

9 EXAMINATION

10 QUESTIONS BY MR. WARNING:

11 Q. Mr. Papageorge, the document you're looking at
12 right now, Papageorge Exhibit No. 26, you said
13 that NVF would have been put on the customer
14 list as of August 13, 1970; correct?

15 A. NVF Kennett Square.

16 Q. Right; they would have been put on that customer
17 list only if they were already not on the
18 customer list; correct?

19 A. Correct.

20 MR. WARNING: Thank you.

21 (Witness excused)
22
23
24
25

1 STATE OF _____)

2 COUNTY OF _____)

3 I, WILLIAM B. PAPAGEORGE, do hereby certify:

4 That I have read the foregoing deposition;

5 That I have made such changes in form
6 and/or substance to the within deposition as
7 might be necessary to render the same true and
8 correct;

9 That having made such changes thereon, I
10 hereby subscribe my name to the deposition.

11 I declare under penalty of perjury that
12 the foregoing is true and correct.

13 Executed this _____ day of

14 _____, 1997,

15 at _____.

16 _____
17 _____

18 NOTARY PUBLIC

19
20 My Commission expires: _____
21
22

23 _____
24 WILLIAM B. PAPAGEORGE
25

1 CERTIFICATE OF REPORTER

2 STATE OF MISSOURI)

3) SS

4 COUNTY OF ST. LOUIS)

5 I, NANCY A. KUNCAITIS, a Registered
6 Professional Reporter and Notary Public in and
7 for the State of Missouri, the officer before
8 whom the foregoing deposition was taken, do
9 hereby certify that the witness whose testimony
10 appears in the foregoing deposition was duly
11 sworn by me; that the testimony of said witness
12 was taken by me to the best of my ability and
13 thereafter reduced to typewriting under my
14 direction; that I am neither counsel for,
15 related to, nor employed by any of the parties
16 to the action in which this deposition was
17 taken, and further that I am not a relative or
18 employee of any attorney or counsel employed by
19 the parties thereto, nor financially or
20 otherwise interested in the outcome of the
21 action.

22
23 NOTARY PUBLIC in and for the
24 State of Missouri

25 My commission expires 11-22-97

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WITNESS ERRATA SHEET

WITNESS NAME: William B Papageorge

CASE: NVF Company vs. American Casualty Company of Reading,
Date Taken August 27, 1997 Pennsylvania et al.,

Pg. 2-48

Ln.No. 7

Should Read 1985

Reason for Change Incorrect date

Pg. 2-102

Ln.No. 2

Should Read monochlorobiphenyl, you can have three of those.

Reason for Change Incorrect number

Pg. 2-102

Ln.No. 19

Should Read mono, di, tri configurations add up to 48

Reason for Change Incorrect number

Pg. _____

Ln.No. _____

Should Read _____

Reason for Change _____

Pg. _____

Ln.No. _____

Should Read _____

Reason for Change _____

Pg. _____

Ln.No. _____

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Reason for Change _____

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Reason for Change _____

Pg. _____

Ln.No. _____

Should Read _____

Reason for Change _____

Pg. _____

Ln.No. _____

Should Read _____

Reason for Change _____

William B Papageorge
Witness

1 STATE OF Missouri)

2 COUNTY OF Saint Louis)

3 I, WILLIAM B. PAPAGEORGE, do hereby certify:

4 That I have read the foregoing deposition;

5 That I have made such changes in form
6 and/or substance to the within deposition as
7 might be necessary to render the same true and
8 correct;

9 That having made such changes thereon, I
10 hereby subscribe my name to the deposition.

11 I declare under penalty of perjury that
12 the foregoing is true and correct.

13 Executed this 7th day of
14 October, 1997,

15 at St. Louis County, State of Missouri.

16 Homer N. Mastorakos
17

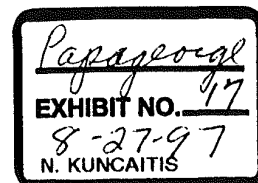
18 NOTARY PUBLIC

HOMER N MASTORAKOS
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. OCT. 28, 1998

19
20 My Commission expires: _____

21
22 William B Papageorge
23

24 WILLIAM B. PAPAGEORGE
25



AROCLOR® PLASTICIZERS

A series of inert, chemically resistant, fire retarding plasticizers compatible with a wide variety of resins.

NYF 000068

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NVF 000069

Properties as Plasticizers

The Aroclor® resins/plasticizers and their blends have an unusual combination of properties which make them extremely useful products. Their most important characteristics are:

Low Cost
Highly Compatible
Chemically Stable
Fire Retardant
Excellent Adhesion

Another very useful aspect of this product line is the fact that a continuous range of properties can be achieved by using combinations of the Aroclors and their blends. Some of the physical properties which can be controlled through product selection are shown on the following pages.

Our Aroclor® product line is now made up of polychlorinated terphenyls, monochlorinated biphenyl, and blends of these products. None of these materials has been shown to create any environmental problems. On the other hand, Food and Drug Administration approval has not been obtained for any of these products. Accordingly, the Aroclor® plasticizers should not be used in connection with food or food-related products, with food wrapping or food container materials. Further, Monsanto strongly recommends that these products not be used in any other application such as non-FDA regulated food systems, in potable water systems, in any animal feeding systems, or in pharmaceuticals.

NVF 000070

Key to Nomenclature

5400 Series

These products are chlorinated terphenyls. The last two digits indicate the chlorine content of the material, e.g., Aroclor® 5460 is a chlorinated terphenyl with 60 percent chlorine. Undistilled Aroclors® are available and are designated by a 5000 series vs. the 5400 series. They are somewhat higher in color but otherwise have product characteristics similar to the distilled products.

6000 Series

These products are blends of Aroclor® 5460 and Aroclor® 1221- a biodegradable monochlorinated biphenyl. The last two digits are an indication of the proportion of Aroclor® 5460 in the blend, e.g., Aroclor® 6062 has more Aroclor® 5460 in it than does Aroclor® 6050.

Miscellaneous Blends

Other product blends containing such other materials as Santicizer 140 for improved fire retardancy, or toluene/xylene for lower viscosities will also be made available as the demand for these specialty products develops.

NVF 000071

AROCLORS

	<u>5432</u>	<u>5442</u>	<u>5460</u>
Adhesion/Tack	_____	increasing	_____→
Hardness	_____	increasing	_____→
Flexibility	_____	decreasing	_____→
Fire Retardance	_____	increasing	_____→
Volatility	_____	decreasing	_____→
Chlorine Content	_____	increasing	_____→
Viscosity	_____	increasing	_____→
Density	_____	increasing	_____→
Permanence	_____	increasing	_____→
Compatibility	_____	decreasing	_____→

NVF 000072

AROCLOL BLENDS

	6040	6050	6062	6070	6090
Adhesion/Tack			increasing		
Hardness			increasing		
Flexibility			decreasing		
Fire Retardance			increasing		
Volatility			decreasing		
Chlorine Content			increasing		
Viscosity			increasing		
Density			increasing		
Permanence			increasing		
Compatibility			decreasing		

NVF 000073

Applications by Product

Listed below are some of the applications where these products can be used:

Aroclor Blends

- | | |
|------|---|
| 6040 | Polyvinyl Acetate Emulsion Adhesives
SBR Adhesives
Miscellaneous applications where a high degree of flexibility is required. |
| 6050 | Chlorinated Rubber and other Resin systems for Coatings.
Inks |
| 6062 | Polysulfide Sealants/Adhesives
Chlorinated Rubber Coatings and Adhesives
SBR Coatings and Adhesives
Miscellaneous applications where high chlorine content, high tack, are required.
Inks |
| 6070 | Polysulfide Adhesives
Chlorinated Rubber Adhesives
Miscellaneous applications where very high chlorine content and very high tack are required. |
| 6090 | Radiation Curing Applications |

NVF 000074

Aroclors

5432	Polysulfide Sealants/Adhesives Chlorinated Rubber Coatings and Adhesives SBR Coatings and Adhesives
5442	Surface Coatings
5460	Hot Melt Adhesives, Surface Coatings

NVF 000075

AROCLOR MARKETS

<u>Aroclor Applications</u>	<u>Polymers and/or Binders</u>	<u>Aroclor Recommended</u>
<u>Adhesives</u>		
Delayed Tack	SBR, PVAc, PS	6090, 5460
Emulsion	PVAc, SBR, Acrylic-VAc, Acrylic-ethylene	1221-B, 6040, 6062
Pressure Sensitive	Natural Rubber, SBR, Cl Rubber	1221-B, 6062, 6090
Hot Melt	EVAc, PVB, Phenoxies, Polyamides	5460, 5465, 5000, Montar 5
<u>Sealants</u>		
	Polysulfide, Nitrile Epoxy, Polyurethane	5460/S-261, HB-40, 6070, 5000
<u>Caulking Compounds</u>		
	Acrylics	5460, 6070
<u>Surface Coatings</u>		
Paints	PVAc, PVC, Nitriles, Styrene, Acrylics	5460, 6062, 6090
Lacquers	Alkyd, Cl Rubber	5460, 6062, 6090

NVF 000076

AROCOR MARKETS (Continued)

<u>Aroclor Applications</u>	<u>Polymers and/or Binders</u>	<u>Aroclor Recommended</u>
<u>Surface Coatings</u> (Continued)		
Varnish	Polysulfide	6070
Paper Coatings	Ethyl Cellulose	6040, 6050
<u>Printing Inks</u>	Nitrocellulose, Acrylic	5460, 6070, 6090
<u>Miscellaneous</u>		
Lost Wax Casting	Wax	5442, 5460, 5462
Impregnating Phenolic Resistors	Resinox, PVC	5460, 6062
Laminating Resins	Phenolic	5460, 6070
Epoxy Resins	Epoxy	6062, 6070

NVF 000077

DELAYED TACK ADHESIVES

Total Market for Plasticizers: 3-4 Million Pounds/Year

Typical Formulations:

<u>Component</u>	<u>Parts by Weight</u>
1. Diphenyl Phthalate	60.6
Cumar W 12	15.1
Lustrex 15	24.3
2. Vinsol Resin	50.0
Santicizer 1-H	50.0
Acrysol M. R.	10.0
Thinned amine dispersant	250.0
<u>Thinned amine dispersant</u>	
Steric Acid	1
Poly-pale Resin	1
2-amino-2-methyl-1-propanol	1
Water	3

Properties Desired:

1. Activation at specific temperature.
2. Remains tacky for specific time period.
3. Remains bonded over wide temperature range.

Current Recommendations:

1. Dicyclohexyl Phthalate - DCHP
2. Diphenyl Phthalate
3. Santicizer 1-H
4. Aroclor 5460
5. Aroclor 6090

NVF 000078

EMULSION ADHESIVES

Total Market for Plasticizers: 35-40 Million Pounds/Year

Typical Formulations:

Gelva S-55	90
Santicizer 218-A	10
	<u>100</u>

Gelva TS-65	90
Santicizer 885	10
	<u>100</u>

Gelva S-77	90
Aroclor 1221-B	10
	<u>100</u>

Gelva TS-100	90
Aroclor 6040	10
	<u>100</u>

Aircoflex 400	95
Aroclor 6050	5
	<u>100</u>

Gelva TS-100	65
Aroclor 1221	10
Staybelite Ester 10	15
Butyl Acetate	10
Santomerse SX	0.1
	<u>100.1</u>

Properties Desired:

1. Controlled wet tack: in most cases, the shorter the wet tack time before the adhesive grabs, the better.
2. Open time of at least one minute: open time is the time during which two adhered substrates can be adjusted after making contact.
3. Physical properties of adhesive film: the cohesive strength of the adhesive must be strong enough to hold the substrates together.

NVF 000079

EMULSION ADHESIVES (Continued)

4. Relatively high heat delamination temperature: this depends on the film forming polymers, the type and amount of plasticizer.
5. Good resistance to water: prolonged immersion in water causes loss of adhesion by most emulsion adhesives at elevated temperatures.

NVF 000080

PRESSURE SENSITIVE ADHESIVES

Total Market for Plasticizers: 30 Million Pounds/Year

Typical Formulations:

<u>Component.</u>	<u>Parts by Weight</u>
1. <u>Calendered into Fabric</u>	
Cellulose Acetate	1
Sartticizer 8	3
Sartolite MHP	2
2. <u>Hot Melt Type</u>	
Crepe Rubber	15
Polyisobutylene	15
Ester Gum	20
Santolite MHP	20
Aroclor 6070	30
Wax	10

Properties Desired:

1. Low volatility
2. Good heat stability
3. High flow/spreadability at elevated temperatures
4. Good moisture resistance
5. Broad use temperature range

NVF 000081

PRESSURE SENSITIVE ADHESIVES (Continued)

Current Recommendations:

1. Santicizer 160
2. Santicizer 148
3. Aroclor 5460, 6040, 6070
4. Santclite MHP

NVF 000082

HOT MELT ADHESIVES

Total Market for Plastifier/Tackifier: 30-40 Million Pounds/Year

Typical Formulations:

<u>Component</u>	<u>Parts by Weight</u>
1. <u>Basic Formula</u>	
EVAc	30
Aroclor 5460	40
Microcrystalline Wax	30
2. <u>Alkali Dispersable Bookbinding Adhesive</u>	
PVA:	40
Sanicizer 160	8
Aroclor 5432	26
Nevellac Hard	24
Acrowax C	1
Sodium Benzoate	0.75

Properties Desired:

1. Good heat stability
2. Sharp melting point
3. Satisfactory viscosity/temperature relationship
4. Bond flexibility
5. Adhesion

NVF 000083

HOT MELT ADHESIVES (Continued)

Current Recommendations:

1. Aroclor 5460, 5465
2. Aroclor 5060, Montar 5
3. Santicizer 160, 141, 148
4. Santicizer 8

NVF 000084

POLYSULFIDE SEALANTS

Typical Formulation:

Thiokol LP-2	100
Lead dioxide paste (50% PbO ₂ , 45% S-160, 5% St. acid)	15
Plasticizer	<u>30</u> <u>145</u>

Fillers such as SRF black, MT black, Lithopone, Zinc Sulfide and York Whiting may be included in the 15 to 75 phr range.

Properties Desired:

1. Adhesions
2. Specific Rate of Cure
3. Specific Creep Characteristics
4. Shelf Stability
5. Pot Life

Current Recommendations

1. Santicizer 261
2. HB-40
3. Blends of Aroclor 5460/S-261 (Santicizer 326)
4. Aroclor 5460/S-160
5. Santicizer 148

NVF 000085

CHLORINATED RUBBER COATINGS

Typical Formulation:

Parlon S-10	35
Epon 828	1
Epichlorhydrin	0.2
Xylene	100
Plasticizer	25
TiO ₂	38.4
Carbon Black	<u>C.4</u> <u>200.0</u>

Properties Desired:

1. Water impermeability
2. Chemical resistance
3. Adhesion to substrate
4. Flexibility

Current Recommendations:

1. Aroclor 6062
2. Aroclor 5432
3. Phthalate ester (if not chem. resistance req.)
4. Aroclor 5460/Santicizer 711 3/1 or 4/1

NVF 000086

ACRYLIC LACQUER

Typical Formulation:

Lucite 6011 or 6012	250 (~100 solids)
1/2 sec. cellulose acetate butyrate	0 to 40
Plasticizer	20 to 40

Properties Desired:

1. Good adhesion
2. Superior pigment wetting
3. Resistance to water and dilute alkalis
4. Excellent weatherability
5. Good abrasion resistance
6. Toughness over a broad temperature range
7. Low volatility of the plasticizer

Current Recommendations:

1. Santicizer 261
2. Aroclor 6062
3. Aroclor 5442
4. Santicizer 140
5. Santicizer 160

NVF 000087

TYPICAL PHYSICAL PROPERTIES OF AROCLORS AND AROCLOR BLENDS

Property	AROCLORS				AROCLOR BLENDS				
	Aroclor 1221-B	Aroclor 5432	Aroclor 5442	Aroclor 5460	Aroclor 6040	Aroclor 6050	Aroclor 6062	Aroclor 6070	Aroclor 6090
Appearance	Clear, mobile oil	Clear, yellow viscous liquid	Clear, yellow sticky resin	Clear, yellow to amber brittle resin or flakes	Clear, light yellow mobile oil	Clear, light yellow mobile oil	Clear, yellow viscous liquid	Light yellow sticky resin	Light yellow resin
Color, Maximum	100 APHA*	2 NPA* (Molten)	2 NPA* (Molten)	2 NPA* (Molten)	2 NPA*	2 NPA*	2 NPA*	2 NPA*	2 NPA*
Specific Gravity	1.125 - 1.140 (25°/ 15.5° C)	1.280* - 1.300 (90°/ 15.5° C)	1.470 (25°/ 25° C)	1.670 (25°/ 25° C)	1.326* - 1.346 (25°/ 15.5° C)	1.344* - 1.357 (65°/ 15.5° C)	1.407* - 1.427 (65°/ 15.5° C)	1.425* - 1.440 (90°/ 15.5° C)	-
Acidity, Maximum (mg KOH/Gm)	0.014*	-	.05*	.05*	0.035*	.035*	0.035*	.035*	.035*
Moisture ppm Maximum	-	-	-	-	250*	250*	250*	250*	-
Refractive Index (20° C)	-	1.638 - 1.650	1.659 - 1.662	1.660 - 1.665	1.6334	1.6390	1.6463	1.6507	1.6500

NVE 000000

WATER_PCB-SD0000074568

TYPICAL PHYSICAL PROPERTIES OF AROCLORS AND AROCLOR BLENDS

Property	AROCLORS				AROCLOR BLENDS				
	Aroclor 1221-B	Aroclor 5432	Aroclor 5442	Aroclor 5460	Aroclor 6040	Aroclor 6050	Aroclor 6052	Aroclor 6070	Aroclor 6090
Viscosity (ASTM D-88)	38 (100° F SUS)	50-60 (210° F SUS)	300-400 (210° F SUS)	-	106-146* (100° F SUS)	110-125* (130° F SUS)	54-64* (210° F SUS)	82-102* (210° F SUS)	-
Flash Point ° F Minimum (Cleveland Open Cup)	260	470° F	477	None to Boiling	260	260	260	260	340
Fire Point ° F Minimum (Cleveland Open Cup)	280	660° F	> 662	None to Boiling	300	310	320	325	550
Softening Point ° C	-	-	46-52*	98-105.5*	-	-	-	-	64-70*

*Monsanto Specification

NVF 000089

Toxicity and Safe Handling

Inhalation

At ordinary temperatures, the Aroclor chlorinated polyphenyls have not presented industrial toxicological problems. The hazard of potential toxic exposure varies with their volatility: the lower-chlorinated, more volatile ones present more of a potential problem from the standpoint of both inhalation and skin contact. When Aroclor plasticizers are used at elevated temperatures, engineering controls must be applied, either by the use of closed systems or by effective local-exhaust ventilation together with general workroom exhaust.

Vapor of the liquid Aroclor plasticizers at room temperature should not be breathed in a confined space, and no vapor of any Aroclor evolved at elevated temperatures should be allowed to be dispersed into the general workroom.

Skin Contact

Continuous or repeated skin contact with the Aroclor plasticizers must be avoided by the use of gloves and protective garments, because of the possible occurrence of a condition called chloracne. Although reports of this condition caused by Aroclor are rare, it can be produced by excessive skin contact. If any Aroclor is spilled on the skin, the skin should be washed in the usual manner with a soap solution.

A burn caused by contact with a hot Aroclor should be treated like any ordinary burn. Aroclor plasticizer adhering to the burned area need not be removed immediately, unless treatment of the burn demands it, in which case either soap and water or repeated washings with a vegetable oil are recommended.

NVF 000090

DISTRICT SALES OFFICES ALL DIVISIONS

ATLANTA, GEORGIA 30326

Lenox Towers East
3400 Peachtree Rd. N. E. — Suite 1711
Tel. (404) 577-2260

BOSTON, MASSACHUSETTS 02149

Everett Station
Tel. (617) 357-5010

CHICAGO, ILLINOIS

3158 Des Plaines Ave.
Des Plaines, Illinois 60018
Tel. (312) 296-6588

CINCINNATI, OHIO 45206

1501 Madison Road
Tel. (513) 751-6707

CLEVELAND, OHIO 44122

3645 Warrensville Center Rd.
Tel. (216) 991-5400

DETROIT, MICHIGAN 48235

500 Northland Towers East
Tel. (313) 357-0910

HONOLULU, HAWAII 96812

205 Pacific International Bldg.
677 Ala Moana Blvd., P. O. Box 3824
Tel. (808) 512-744

HOUSTON, TEXAS 77002

1300 Main Street
Tel. (713) Capitol 3-4011

LOS ANGELES, CALIFORNIA 90022

6670 E. Flotilla St.
Tel. (213) 723-2492

MINNEAPOLIS, MINNESOTA 55402

912 Northstar Center 110 S. Seventh St.
Tel. (612) 339-4651

NEW YORK, NEW YORK 10017

277 Park Avenue
Tel. (212) 922-4111

PITTSBURGH, PENNSYLVANIA 15222

No. 4 Gateway Center Bldg. Room 534
Tel. (412) 261-2156

ST. LOUIS, MISSOURI 63166

800 N. Lindbergh Blvd.
Tel. (314) Oxford 4-1000

SAN FRANCISCO BAY AREA

2710 Lafayette, Santa Clara, Calif. 95052
Tel. (408) 243-0414

SEATTLE, WASHINGTON 98104

911 Western Avenue
Tel. (206) Main 2-4203

SPRINGFIELD, MASSACHUSETTS 01101

730 Worcester Ave.
Tel. (413) 783-6911

WILMINGTON, DELAWARE 19803

2005 Concord Pike, Fairfax
Tel. (302) Olympia 8-6531

MONSANTO, 800 N. LINDBERGH BLVD., ST. LOUIS, MISSOURI 63166

*Additional District Offices
are maintained by:*

Agricultural Division

LULING, LOUISIANA 70070

P. O. Box 174
Tel. (504) 784-6263

MEMPHIS, TENNESSEE 38113

1073 Riverside Drive
P. O. Box 13248
Tel. (901) Whitehall 7-3151

Textiles Division

AKRON, OHIO 44313

3030 West Market St.
Tel. (216) 836-7941

ATLANTA, GEORGIA 30303

Atlanta Merchandise Mart
240 Peachtree St. N. W.
Tel. (404) 577-2260

CHARLOTTE, NORTH CAROLINA 28202

Wachovia Bank Building
129 West Trade St.
Tel. (704) 376-9871

ENGLEWOOD CLIFFS, N. J. 07631

661 Palisades Ave.
Tel. (201) 568-2151

NEW YORK, NEW YORK

350 Fifth Ave.
Tel. (201) 556-5100

Hydrocarbons & Polymers Division-Lion Oil

EL DORADO, ARKANSAS 71730

Lion Oil Building
Tel. (501) Union 3-3111

JACKSON, MISSISSIPPI 39209

P. O. Box 10937
Westland Station
Tel. (601) 352-3648

LITTLE ROCK, ARKANSAS 72203

1515 West Seventh St.
Tel. (501) Franklin 6-2437

MEMPHIS, TENNESSEE 38113

1023 Riverside Drive
P. O. Box 13248
Tel. (901) Whitehall 7-3151

Organic Chemicals Division (Rubber Industry)

AKRON, OHIO 44311

120 Brown Street
P. O. Box 2307
Tel. (216) Hemlock 4-1921

NVF 000091

Monsair

DICTATE IN SEQUENCE:

1. HEADING INFORMATION
2. NAMES OF ADDRESSEES
3. NAMES OF CARBONEES
4. IMMEDIATE ACTION NEEDED
5. REPORT ON CALL

REPORT CAPTIONS:

1. OBJECTIVE
2. PERSONS CONTACTED
3. RESULTS
4. ACTION REQUIRED

CUSTOMER NAME NVF		DATE OF CALL 5/5/71	
CITY AND STATE Kennett Square, Pennsylvania		DATE RECEIVED 5/6/71	DATE TYPED 5/10/71
CUSTOMER MAILING LIST CHANGES - SERVICE CENTER USE ONLY			
NAME AND TITLE	PUT ON	TAKE OFF	MP
REGION Eastern	SERVICE CENTER Wilmington	SALESMAN John M. Van Gelder	

TO C. P. Farley - St. Louis CC W. S. Clark - St. Louis

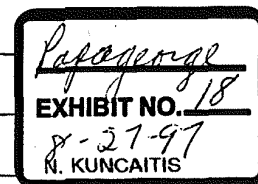
Contacted: Ken Hayes - Purchasing Agent.

Objective: Discuss Aroclor 6062

Result:

Hayes indicated that the change from A-1254 to A-6062 went very smoothly. NVF has found they only need to use about 70% as much A-6062 as they used A-1254 to obtain the same flame retardance. Usage should be about 7,000 lbs/month.

NVF - Willow Grove, Pa., manufactures polyester glass sheets and mats -- presently using antimony oxide for flame retardant.



Monsanto

DICTATE IN SEQUENCE:

1. HEADING INFORMATION
2. NAMES OF ADDRESSEES
3. NAMES OF CARBONEES
4. IMMEDIATE ACTION NEEDED
5. REPORT ON CALL

REPORT CAPTIONS:

1. OBJECTIVE
2. PERSONS CONTACTED
3. RESULTS
4. ACTION REQUIRED

CUSTOMER NAME NVE		DATE OF CALL 8-26-71	
CITY AND STATE Kennett Square, Pennsylvania		DATE RECEIVED 8-30-71	DATE TYPED 8-31-71
CUSTOMER MAILING LIST CHANGES - SERVICE CENTER USE ONLY			
NAME AND TITLE		PUT ON	TAKEN OFF
		MP	MAG.
		CATEGORY CODES	
REGION Southeastern	SERVICE CENTER Wilmington	SALESMAN J. M. Van Gelder	

TO J. H. Orem, St. Louis

CC F. G. Sutton, Wilmington
J. R. Darby, St. Louis
R. W. Bucknell, St. Louis
W. S. Clark, St. Louis

CONTACTED: Ken Hayes, Purchasing Agent

OBJECTIVE: Discuss A-6062.

RESULTS:

- (1) Hayes indicated that Aroclor 6062 continues to be the product of choice as the flame retardant in their phenolic sheet application. July and August are usually quite slow for NVE, but Hayes indicates an expected usage of 6,000/lbs. per month when things return to normal levels.

DICTATE IN SEQUENCE:

1. HEADING INFORMATION
2. NAMES OF ADDRESSEES
3. NAMES OF CARBONEES
4. IMMEDIATE ACTION NEEDED
5. REPORT ON CALL

REPORT CAPTIONS:

1. OBJECTIVE
2. PERSONS CONTACTED
3. RESULTS
4. ACTION REQUIRED

CUSTOMER NAME NVE		DATE OF CALL 12-21-71	
CITY AND STATE Kennett Square, Pennsylvania		DATE RECEIVED 1-3-72	DATE TYPED 1-3-72
CUSTOMER MAILING LIST CHANGES - SERVICE CENTER USE ONLY			
NAME AND TITLE	PUT ON	TAKE OFF	MP MAG CATEGORY CODES
REGION Southeastern	SERVICE CENTER Wilmington	SALESMAN J. M. Van Gelder	

J. H. Orem, St. Louis

CC F. G. Sutton, Wilmington
R. W. Bucknell, St. Louis
J. R. Darby, Queeny
W. S. Clark, St. Louis
A. Morgan, Queeny

CONTACTED: Ken Hayes, Purchasing Agent
Joe Pesce, Chemist

OBJECTIVE:

- (1) Announce the aroclor discontinuation and discuss possible alternatives.

RESULTS:

- (1) Informed Hayes of the discontinuation of A-6062. This news was not at all well received. He feels that they should receive more A-6062 than the policy allows because of cyclical buying patterns.

NVE uses A-6062 as a flame retardant in a paper based phenolic system. A new candidate must have good dip solder resistance, electrical insulation and surface flame retardency characteristics. My initial recommendations were S-140, TCP, and TPPI. Any other recommendations would be greatly appreciated.

NXF 000116

Monsanto

1

FROM (NAME & LOCATION)

Fred G. Sutton - Wilmington

DATE

December 29, 1971

CC

J. M. Van Gelder
B. R. Dollimont

SUBJECT

NVF

REFERENCE

TO

~~Willis Clark~~

AF
Discussed Aroclor situation with Ken Hays of NVF. Told him that we would supply 15,000 pounds of Aroclor 6062 during the first quarter of 1972. He will enter and order with COP for this amount.


Fred G. Sutton

FGS/dcs

NVF 000117

WATER_PCB-SD0000074575

Form Approved OMB
No. 44-R1387
Approval Expires:
July 30, 1972

U.S. DEPARTMENT OF LABOR

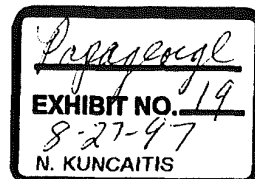
Form No. OSHA-20
May, 1971

81111

MATERIAL SAFETY DATA SHEET

SECTION I				
MANUFACTURER'S NAME MORGANTO COMPANY			EMERGENCY TELEPHONE NO. (314) 694-1000	
ADDRESS (Number, Street, City, State, and Zip Code) 800 North Lindbergh Boulevard, St. Louis, Missouri 63166				
CHEMICAL NAME AND SYNONYMS Mixture			TRADE NAME AND SYNONYMS Reclaimed Aroclor	
FORMULA Chlorinated Aromatic			FORMULA Mixture	
SECTION II HAZARDOUS INGREDIENTS				
PAINTS, PRESERVATIVES, & SOLVENTS	TLV (Units)	ALLOYS AND METALLIC COATINGS	TLV (Units)	
PIGMENTS		BASE METAL		
CATALYST		ALLOYS		
VEHICLE		METALLIC COATINGS		
SOLVENTS		FILLER METAL PLUS COATING OR CORE FILL		
ADDITIVES		OTHERS		
OTHERS				
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				TLV (Units)
SECTION III PHYSICAL DATA				
BOILING POINT (°F.) at 40 mm	200-400°C	SPECIFIC GRAVITY (H ₂ O = 1) (15/15°C)	1.25-1.55	
VAPOR PRESSURE (mm Hg.) at 20°C	<1 mm	PERCENT VOLATILE BY VOLUME (%)	N.A.	
VAPOR DENSITY (AIR = 1)	Not Avail	EVAPORATION RATE (BuAc = 1)	<1	
SOLUBILITY IN H ₂ O at 20°C	negligible	<0.02		
APPEARANCE AND ODOR	colorless to yellow oil	sharp aromatic odor		
SECTION IV FIRE AND EXPLOSION HAZARD DATA				
FLASH POINT (INSTRUC METHOD)	Not Avail.		Let	Unit
EXTINGUISHING MEDIA				
SPECIAL FIRE FIGHTING PRECAUTIONS	Respiratory protection when fighting fires where exposure to vapors or gases is possible.			
UNUSUAL FIRE AND EXPLOSION HAZARDS	Highly toxic gases (chlorides and chlorine) can be evolved in fires of this product.			

NVF 003625



Reclaimed
Aroclor

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
EFFECTS OF OVEREXPOSURE Skin irritation in the form of chloracne, systematic intoxication, leads to nausea, vomiting, loss of weight, edema and abdominal pain.
EMERGENCY AND FIRST AID PROCEDURES Remove from exposure. Remove contaminated clothing. Wash contacted area with large amounts of water and soap. Refer to physician.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE	CONDITIONS TO AVOID
	STABLE	X
INCOMPATIBILITY (Materials to avoid)		
HAZARDOUS DECOMPOSITION PRODUCTS CO, CO ₂ , smoke, soot, chlorides and chlorine		
HAZARDOUS POLYMERIZATION	MAY OCCUR	CONDITIONS TO AVOID
	WILL NOT OCCUR	X

SECTION VII SPILL OR LEAK PROCEDURES

TIME TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Absorb on clay, sawdust or other absorbant material. Place in drums. Bury in approved chemical landfill in accordance with local and state regulations.
WASTE DISPOSAL METHOD Burn in an approved incinerator in accordance with local and state regulations.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Bureau of Mines approved respirator for organic vapors.		
VENTILATION	LOCAL EXHAUST Yes - for vapors	SPECIAL
	MECHANICAL (General)	OTHER
PROTECTIVE GLOVES	Rubber	EYE PROTECTION Chemical goggles
OTHER PROTECTIVE EQUIPMENT		

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid skin and eye contact, avoid inhalation of vapors
OTHER PRECAUTIONS

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, MONSANTO COMPANY MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

JAC:HOH:JTG:MBP

2/3/72

NVF 003626

Form Approved OMB
No. 44-R1387
Approval Expires:
July 30, 1972

U.S. DEPARTMENT OF LABOR

Form No. OSHA-10
May, 1971

81102

MATERIAL SAFETY DATA SHEET

SECTION I					
MANUFACTURER'S NAME MONSANTO COMPANY				EMERGENCY TELEPHONE NO. (314) 691-1000	
800 North Lindbergh Boulevard, St. Louis, Missouri 63166					
CHEMICAL NAME AND SYNONYMS Mixture				TRADE NAME AND SYNONYMS Aroclor 1248	
CHEMICAL FAMILY Chlorinated aromatic				FORMULA Mixture	
SECTION II. HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS	1	TLV (Units)	ALLOYS AND METALLIC COATINGS	2	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				3	TLV (Units)
SECTION III PHYSICAL DATA					
BOILING POINT (°F.)	760 mm	346-385°C	SPECIFIC GRAVITY (H ₂ O = 1) (25/25°C)	1.415	
VAPOR PRESSURE (mm Hg.)	165-210°C	3 mm	PERCENT VOLATILE BY VOLUME (%)	N.A.	
VAPOR DENSITY (AIR = 1)	Not Avail		EVAPORATION RATE (BuAc = 1)	<1	
SOLUBILITY IN WATER	20°C negligible		<0.01%		
APPEARANCE AND ODOR	colorless to yellow oil aromatic odor				
SECTION IV FIRE AND EXPLOSION HAZARD DATA					
FLASH POINT (Method used)	C.O.C. 196°C		FLAMMABLE LIMITS	Lo	Hi
EXTINGUISHING MEDIA	N.A. N.A.				
SPECIAL FIRE FIGHTING PROCEDURES Respiratory protection when fighting fires where exposure to vapor or gases is possible:					
UNUSUAL FIRE AND EXPLOSION HAZARDS Highly toxic gases (chlorides and chlorine) can be evolved in fires of this product.					

NVF 003635

Aroclor 1248

SECTION V

HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE

Skin irritation in the form of chloracne. Systematic intoxication leads to nausea, vomiting, loss of weight, edema and abdominal pain.

EMERGENCY AND FIRST AID PROCEDURES

Remove from exposure. Remove contaminated clothing. Wash contacted area with large amounts of water and soap. Refer to physician.

SECTION VI

REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

STABLE

X

INCOMPATIBILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

CO, CO₂, smoke, soot, chlorides and chlorine.HAZARDOUS
POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

WILL NOT OCCUR

X

SECTION VII

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Absorb on clay, sawdust or other absorbant material. Place in drums. Bury in approved chemical landfill in accordance with local and state regulations.

WASTE DISPOSAL METHOD

Burn in an approved incinerator in accordance with local and state regulations.

SECTION VIII

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

Bureau of Mines approved respirator for organic vapors.

VENTILATION

LOCAL EXHAUST

Yes - for vapors

SPECIAL

MECHANICAL (General)

OTHER

PROTECTIVE GLOVES

Rubber

EYE PROTECTION

Chemical goggles

OTHER PROTECTIVE EQUIPMENT

SECTION IX

SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Avoid skin and eye contact, avoid inhalation of vapors.

OTHER PRECAUTIONS

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, MONSANTO COMPANY MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

JAG:HOH:JTG:WBP

1/25/72

NMF 003636

Form Approved OMB
No. 44-R1387
Approval Expires:

U.S. DEPARTMENT OF LABOR

Form No. OSHA-
May, 1971

July 30, 1972

MATERIAL SAFETY DATA SHEET

SECTION I					
MANUFACTURER'S NAME MONSANTO COMPANY				EMERGENCY TELEPHONE NO. (314) 694-1000	
ADDRESS, Street, City, State, and ZIP Code 500 North Lindbergh Boulevard, St. Louis, Missouri 63166					
CHEMICAL NAME AND SYNONYMS Mixture			TRADE NAME AND SYNONYMS Aroclor 1254		
FORMULA Chlorinated aromatic			FORMULA Mixture		
SECTION II HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS		%	TLV (Mgms)	ALLOYS AND METALLIC COATINGS	
Pigments				BASE METAL	
Catalyst				ALLOYS	
Vehicle				METALLIC COATINGS	
Solvents				FILLER METAL PLUS COATING OR CORE FILL	
Additives				OTHERS	
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Mgms)
SECTION III PHYSICAL DATA					
BOILING POINT °F		760 mm	365-400°C	SPECIFIC GRAVITY IN °F (25/25°C)	
VAPOR PRESSURE mm Hg		180-220°C	3 mm	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR = 1)				EVAPORATION RATE (G/GAL-HR)	
SOLUBILITY IN WATER		200°C	negligible	<0.01%	
APPEARANCE AND ODOR		Yellow viscous oil aromatic odor			
SECTION IV FIRE AND EXPLOSION HAZARD DATA					
FLASH POINT (Mgms)		None		FLAMMABLE LIMITS	
EXTINGUISHING MEDIA					
SPECIAL FIRE FIGHTING PROCEDURES					
Respiratory protection when fighting fires where exposure to vapors or gases is possible.					
Hazardous decomposition products (chlorides and chlorine) can be evolved in fires of this product.					

NVF 003637

THRESHOLD LIMIT VALUE		0.5 mg/m ³ of air
EFFECTS OF OVEREXPOSURE Skin irritation in the form of chloracne, systematic intoxication leads to nausea, vomiting, loss of weight, edema and abdominal pain.		
EMERGENCY AND FIRST AID PROCEDURES Remove from exposure. Remove contaminated clothing. Wash contacted area with large amounts of water and soap. Refer to physician.		

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS CO, CO ₂ , smoke, soot, chlorides and chlorine			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

Absorb on clay, sawdust or other absorbant material. Place in drums. Bury in approved chemical landfill in accordance with local and state regulations.	
WASTE DISPOSAL METHOD Burn in an approved incinerator in accordance with local and state regulations.	

SECTION VIII SPECIAL PROTECTION INFORMATION

Bureau of Mines approved respirator for organic vapors.			
VENTILATION	LOCAL EXHAUST	Yes - for vapors	SPECIAL
	MECHANICAL (General)		OTHER
PROTECTIVE GLOVES		Rubber	EYE PROTECTION
			Chemical goggles
OTHER PROTECTIVE EQUIPMENT			

SECTION IX SPECIAL PRECAUTIONS

Avoid skin and eye contact, avoid inhalation of vapors	
OTHER PRECAUTIONS	
NVF 003638	

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, MONSANTO COMPANY MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

JAG:HOH:JTG:WBP

1/25/72

Form Approved OMB
No. 44-R1387
Approval Expires:
July 30, 1972

U.S. DEPARTMENT OF LABOR

Form No. OSHA-2
May, 1971

MATERIAL SAFETY DATA SHEET

SECTION I					
MANUFACTURER'S NAME MONSANTO COMPANY				EMERGENCY TELEPHONE NO. (314) 694-1000	
ADDRESS, Number, Street, City, State, and ZIP Code 500 North Lindbergh Boulevard, St. Louis, Missouri 63166					
COMMON NAME AND SYNONYMS Mixture				TRADE NAME AND SYNONYMS Aroclor 1254 (A13H1)	
Chemical Name and Synonyms Chlorinated aromatic				Formula Mixture	
SECTION II HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS		%	TLV (Units)	ALLOYS AND METALLIC COATINGS	
Pigments				BASE METAL	
Catalyst				Alloys	
Vehicle				METALLIC COATINGS	
Solvents				FILLER METAL PLUS COATING OR CORE FILL	
Additives				OTHERS	
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
SECTION III PHYSICAL DATA					
BOILING POINT (°F.)		760 mm	365-400°C	SPECIFIC GRAVITY IN H_2O (25/25°C)	
VAPOR PRESSURE (mm Hg.)		180-220°C	3 mm	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)				EVAPORATION RATE 1 Butyl Ac = 1	
SOLUBILITY IN WATER		20°C negligible	<0.01%		
APPEARANCE AND ODOR		Yellow viscous oil		aromatic odor	
SECTION IV FIRE AND EXPLOSION HAZARD DATA					
FLASH POINT (MATERIAL)		None		FLAMMABLE LIMITS	
EXTINGUISHING MEDIA					
SPECIAL FIRE FIGHTING PROCEDURES					
Respiratory protection when fighting fires where exposure to vapors or gases is possible.					
Hazardous decomposition products (chlorides and chlorine) can be evolved in fires of this product.					

NVF 003641

Aroclor 1254

SECTION V

HEALTH HAZARD DATA

HAZARDOUS CONCENTRATION	0.5 mg/m ³ of air
EFFECTS OF OVEREXPOSURE Skin irritation in the form of chloracne, systematic intoxication leads to nausea, vomiting, loss of weight, edema and abdominal pain.	
EMERGENCY AND FIRST AID PROCEDURES Remove from exposure. Remove contaminated clothing. Wash contacted area with large amounts of water and soap. Refer to physician.	

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS CO, CO ₂ , smoke, soot, chlorides and chlorine			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

SPILL OR LEAK PROCEDURES Absorb on clay, sawdust or other absorbant material. Place in drums. Bury in approved chemical landfill in accordance with local and state regulations.	
HAZARDOUS WASTE DISPOSAL METHOD Burn in an approved incinerator in accordance with local and state regulations.	

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Bureau of Mines approved respirator for organic vapors.			
VENTILATION	LOCAL EXHAUST	Yes - for vapors	SPECIAL vapors.
	MECHANICAL (General)		OTHER
PROTECTIVE GLOVES	Rubber	EYE PROTECTION	Chemical goggles
OTHER PROTECTIVE EQUIPMENT			

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE Avoid skin and eye contact, avoid inhalation of vapors	
OTHER PRECAUTIONS	

NVF 003642

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, MONSANTO COMPANY MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

JAG:HOH:JTG:WBP

1/25/72

Monsanto

C O M P A N Y

ORGANIC CHEMICALS DIVISION

800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
(314) OXford 4-1000

March 3, 1969

On February 24, the San Francisco Chronicle carried a major feature about "a menacing new pollutant" found in the San Francisco Bay area. The article was based on marine life research carried out by Dr. Robert Risebrough of the University of California. It stated that residues of polychlorinated biphenyl (PCB) were killing certain marine birds and posed a long-term threat to humans.

This story has caused considerable comment on the West Coast and its claims may be repeated elsewhere. As you know, Monsanto manufactures polychlorinated biphenyl and markets it under our Aroclor trade name. We, therefore, would like to present some additional facts.

The work done by Dr. Risebrough dates back to earlier research by other scientists to analyze the amount of pesticides in wildlife, soil and water. The initial pesticide research was extremely difficult since any search to detect materials in the parts-per-billion range also brings out other "interfering" substances.

NVF 003699

Several years ago, two Swedish scientists at Stockholm University's Institution of Analytical Chemistry, Professor Gunnar Widmark and Soren Jensen, reported they had identified the other substances which were appearing during analysis of chlorinated pesticide residues. They said some of the materials were polychlorinated biphenyls or PCB. The amount reported was in the parts-per-billion range, or less. Since PCB's are not "broadcast" or spread around the land as are pesticides, the scientists theorized that the source must be the industrial wastes of PCB users.

Dr. Risebrough's more recent work reports the identification of PCB, along with DDT and DDE pesticides, in the tissues of birds and fish on the West Coast.

The conclusions of these scientists are puzzling from several aspects. Polychlorinated biphenyls are stable chemical compounds which are essentially insoluble in water. Their use does not make them easily released into the natural environment.

A principal market for PCB is in electrical applications where they are used as insulating fluids for transformers and capacitors. In this use, the chemical is completely sealed in metal containers. Another market is for heat transfer applications where the PCB fluid functions in a closed system.

PCB's are also used in several "plastic type" applications. Here the chemical is incorporated into the polymer as an integral part of the solid material. This applies whether the polymer is used as an adhesive, an elastomer or a surface coating.

The Swedish and American scientists also imply that polychlorinated biphenyls are "highly toxic" chemicals. This is simply not true. The toxicity of any material, whether it be chemicals, drugs, natural plants or even foods, is relative. Compared to the thousands of industrial chemicals and home products, PCB's are not toxic unless they are mishandled or misused. During more than thirty years of U. S. production and use, cases of any toxic effect have been extremely rare -- and then only where the simple precautions recommended for use were not followed.

NVF 003700

To our knowledge, polychlorinated biphenyls are not sprayed or dusted on crops, woodlands or any other areas, as are pesticides. It is, therefore, not only puzzling, but extremely difficult to conceive how commercially produced PCB can show up in wildlife as DDT and other pesticides appear to be. This raises the question whether the substance identified in the Swedish work, and now in California, is actually PCB -- or whether they are materials which, due to the metabolism of other materials in the marine environment, appears to be PCB.

Unfortunately, even though techniques for analyzing tissue samples have become quite precise, the ability to analyze the possible impact of naturally occurring substances in the food cycle of living organisms has not made comparable advances.

Monsanto has a research program to confirm the identity of the compounds reported to be PCB by the Swedish and California scientists. We also cooperate, on a regular basis, with federal, state and university laboratories in their analysis of chlorinated hydrocarbon residues.

Additionally, Monsanto will continue to exercise the highest degree of control in its manufacturing, shipping and storage of PCB -- as we do with all products. In the functional fluids market, we have carried out a program for several years for the reclamation of used PCB's to avoid disposal of these valuable materials.

The source of the marine life residue identified as PCB is not yet known. It will take extensive research, on a worldwide basis, to confirm or deny the initial scientific conclusions. We will keep you advised of our own research and are available to answer questions as they may arise.

Very truly yours,

Elmer P. Wheeler
Manager Environmental Health

/ecd

NVF 003701

Monsanto

C O M P A N Y

ORGANIC CHEMICALS DIVISION

800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
(314) OXford 4-1000

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NVF 003700

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The source of the marine life residue identified as PCB is not yet known. It will take extensive research, on a worldwide basis, to confirm or deny the initial scientific conclusions. We will keep you advised of our own research and are available to answer questions as they may arise.

Very truly yours,

Elmer P. Wheeler
Manager Environmental Health

/ecd

NVF 003701

Monsanto

FROM (NAME & LOCATION)

P. W. Gann - B2SF

DATE

May 9, 1973

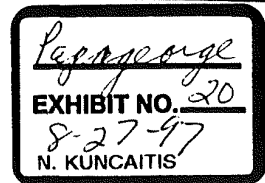
SUBJECT

PCB Warning Letter, August 14, 1970
By Schalk

REFERENCE

TO

Memo to File



This warning letter was sent to the following four distributors:

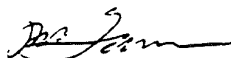
E. M. Toby, President
American Mineral Spirits Co.
Division of Union Oil of California
1345 Avenue of the Americas
New York, New York 10019

Mr. Carl Giloth
Central Solvents & Chemical Co.
2540 West Fluornoy Street
Chicago, Illinois 60612

Mr. W. C. McCall, President
Great Western Chemical Co.
3720 North West Yeon Ave.
Portland, Oregon 97210

Mr. C. J. Turriff, President
Tab Chemical Co.
4801 South Austin
Chicago, Illinois 60638

This is the same list as used in May 25, 1970 letter.


P. W. Gann

/mc

NVF 000063

MONSANTO CHEMICAL COMPANY

800 NORTH LINDEBERGH BOULEVARD
ST. LOUIS 88, MISSOURI

PYDRAUL F-9

TOXICITY AND SAFE HANDLING INFORMATION

Extensive animal experimental work has been done on Pydraul F-9. In the case of oral feedings, it was found that the minimum lethal dose for rats was 10.6 to 15.8 grams per kilogram of body weight. In rabbits, the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of Pydraul F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050°F and 1250°F. In all cases the toxicity was roughly comparable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

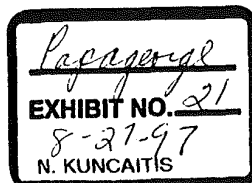
When splashed or sprayed into the eyes, Pydraul F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of Pydraul, copious and prolonged washing is recommended. To relieve the irritation, physicians have used 1% Pontocaine solution as well as ophthalmic cortisone acetate solution.

Regarding the effect of Pydraul F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning off a machine following a breakdown, no such protection is necessary.

R. Emmett Kelly, M. D.
Medical Director

1/7/64

NVF 003585



Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
(314) Oxford 4-1000

PYDRAUL F-9

TOXICITY AND SAFE HANDLING INFORMATION

Extensive animal experimental work has been done on Pydraul F-9. In the case of oral feedings, it was found that the minimum lethal dose for rats was 10.6 to 15.8 grams per kilogram of body weight. In rabbits, the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of Pydraul F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050° F and 1250° F. In all cases the toxicity was roughly comparable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

When splashed or sprayed into the eyes, Pydraul F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of Pydraul copious and prolonged washing is recommended. To relieve the irritation, physicians have used 1% pontocaine solution as well as ophthalmic cortisone acetate solution.

Regarding the effect of Pydraul F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning of a machine following a breakdown, no such protection is necessary.

R. Emmet Kelly

R. Emmet Kelly, M.D.
Medical Director

May 3, 1968

NVF 003595

PYDRAUL F-9

TOXICITY & SAFE HANDLING INFORMATION

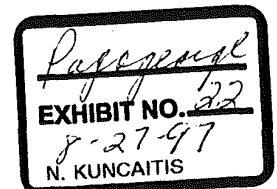
Extensive animal experimental work has been done on Pydraul F-9. In the case of oral feedings it was found that the minimum lethal dose for rats was 10.6 to 15.8 grams per kilogram of body weight. In rabbits the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch-tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of Pydraul F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050°F. and 1250°F. In all cases the toxicity was roughly comparable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

When splashed or sprayed into the eyes, Pydraul F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of Pydraul, copious and prolonged washing is recommended. To relieve the irritation, physicians have used 1% pontocaine solution as well as ophthalmic cortisone acetate solution.

Regarding the effect of Pydraul F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning off a machine following a breakdown, no such protection is necessary.



NVF 003561

TOXICITY OF PYDRAUL FLUIDS

Pydraul F-9

There has been considerable toxicity research on Pydraul F-9. Attached is a discussion and interpretation of the toxicity studies. The results may be summarized in a brief fashion as follows:

In the case of oral feedings, it was found that the minimum lethal dose for rats was 10.0 to 15.8 grams per kilogram of body weight. In rabbits, the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

Pydraul 625

The Oral LD₅₀ of 34.3 grams per kilogram when tested with rats, and the Oral Minimum Lethal Dose of 4.25 to 5.00 grams per kilogram when tested with rabbits indicate that Pydraul 625 may be classed as "relatively harmless" to "slightly toxic" from the standpoint of oral ingestion. Potential irritation studies with rabbits show that it is only a mild irritant to skin and eyes. In acute vapor inhalation studies, rats survived a six-hour exposure to atmospheres saturated with vapors of the product. The above figures are lower than those obtained in studies with Pydraul F-9. This comparison is significant since Pydraul F-9 has been used since 1949 with no reports of skin irritation or other toxic effects.

Pydraul 150

The toxicity report on Pydraul 150 indicates that it is practically innocuous when fed orally to rats since the animals survived single doses of 28.5 grams per kilogram with loss of appetite and severe diarrhea as the only toxic effects. The fluid apparently is not absorbed through the unbroken skin of rabbits since this species survived doses up to 9.5 grams per kilogram of body weight. In rabbit skin and eye irritation studies, Pydraul 150 was no more irritating than a 10% soap solution tested similarly. As indicated with Pydraul F-9, however, Pydraul 150 will cause severe pain if there is accidental splashing in the eyes of humans. Rats survived a six-hour exposure to an atmosphere saturated with Pydraul 150 vapors.

NVF 003566

Pydraul A-200

Our interpretation of the toxicity data obtained on this newer synthetic hydraulic fluid is that accidental ingestion is not a particular hazard in view of the high oral lethal dose (Oral LD₅₀: 10,500 mg/kg). Similarly, single massive skin exposures should not be immediately hazardous (Skin MLD: 625 to 1,250 mg/kg). The lethal dose following skin penetration is such, however, that prolonged and repeated skin contact should be avoided. Such exposure must also be avoided to prevent skin irritation. We also feel that vapor inhalation should be avoided when the fluid is at elevated temperatures. Such exposure again relates to prolonged or repeated exposures rather than massive or acute exposure. In the case of the latter, workmen would probably not voluntarily subject themselves to concentrations that are hazardous for short periods.

Pydraul AC

In animal toxicity studies with Pydraul AC, the oral lethal dose in rats is approximately 40 grams per kilogram and for rabbits, 3.5 to 4.5 grams per kilogram. The greater sensitivity of rabbits is typical of this type of fluid. This lethal dose is of such an order, however, that the fluid may be considered only "slightly toxic" to man from the standpoint of accidental ingestion of single oral doses. The fluid may be absorbed through the unbroken skin of rabbits in doses resulting in death, but again the minimum lethal dose is such that accidental massive skin exposures to man do not present a hazard. Skin and eye irritation studies with rabbits would classify the fluid as a mild irritant. Laboratory animals survived six-hour exposures to an atmosphere saturated with the vapors of the fluid. On the basis of this data, it is concluded that Pydraul AC requires no special handling precautions other than avoiding prolonged or repeated skin contact. Accidental splashing in the eyes will result in moderately severe pain and irritation but no permanent damage should result.

NVF 003567

MONSANTO CHEMICAL COMPANY

800 NORTH LINDBERGH BOULEVARD
ST. LOUIS 60, MISSOURI

PYDRAUL F-9

TOXICITY AND SAFE HANDLING INFORMATION

Extensive animal experimental work has been done on Pydraul F-9. In the case of oral feedings, it was found that the minimum lethal dose for rats was 10.5 to 15.8 grams per kilogram of body weight. In rabbits, the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of Pydraul F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050°F. and 1250°F. In all cases the toxicity was roughly comparable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

When splashed or sprayed into the eyes, Pydraul F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of Pydraul, copious and prolonged washing is recommended. To relieve the irritation, physicians have used 1% Pontocaine solution as well as ophthalmic cortisone acetate solution.

Regarding the effect of Pydraul F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning off a machine following a breakdown, no such protection is necessary.

NVF 003569

TOXICITY OF PYDRAUL FLUIDS

Pydraul F-9

There has been considerable toxicity research on Pydraul F-9. Attached is a discussion and interpretation of the toxicity studies. The results are also summarized in a briefer fashion on page 18 of the enclosed Pydraul F-9 Technical Bulletin.

Pydraul 625

The Oral LD₅₀ of 34.3 grams per kilogram when tested with rats, and the Oral Minimum Lethal Dose of 4.25 to 5.00 grams per kilogram when tested with rabbits indicate that Pydraul 625 may be classed as "relatively harmless" to "slightly toxic" from the standpoint of oral ingestion. Potential irritation studies with rabbits show that it is only a mild irritant to skin and eyes. In acute vapor inhalation studies, rats survived a 6-hour exposure to atmospheres saturated with vapors of the product. The above figures are lower than those obtained in studies with Pydraul F-9. This comparison is significant since Pydraul F-9 has been used since 1949 with no reports of skin irritation or other toxic effects.

Pydraul 150

The toxicity report on Pydraul 150 indicates that it is practically innocuous when fed orally to rats since the animals survived single doses of 28.5 grams per kilogram with loss of appetite and severe diarrhea as the only toxic effects. The fluid apparently is not absorbed through the unbroken skin of rabbits since this species survived doses up to 9.5 grams per kilogram of body weight. In rabbit skin and eye irritation studies, Pydraul 150 was no more irritating than a 10% soap solution tested similarly. As indicated with Pydraul F-9, however, Pydraul 150 will cause severe pain if there is accidental splashing in the eyes of humans. Rats survived a 6-hour exposure to an atmosphere saturated with Pydraul 150 vapors.

Pydraul A-200

Our interpretation of the toxicity data obtained on this newer synthetic hydraulic fluid is that accidental ingestion is not a particular hazard in view of the high oral lethal dose (Oral LD₅₀: 10,500 mg/kg). Similarly, single massive skin exposures should not be immediately hazardous (Skin MLD: 625 to 1,250 mg/kg). The lethal dose following skin penetration is such, however, that prolonged and repeated skin contact should be avoided. Such exposure must also be avoided to prevent skin irritation. We also feel that vapor inhalation should be avoided when the fluid is at elevated temperatures. Such exposure again relates to prolonged or repeated exposures rather than massive or acute exposure. In the case of the latter, workmen would probably not voluntarily subject themselves to concentrations that are hazardous for short periods.

NVF 003571

Pydraul AC

In animal toxicity studies with Pydraul AC, the oral lethal dose in rats is approximately 40 grams per kilogram and for rabbits, 3.5 to 4.5 grams per kilogram. The greater sensitivity of rabbits is typical of this type of fluid. This lethal dose is of such an order, however, that the fluid may be considered only "slightly toxic" to man from the standpoint of accidental ingestion of single oral doses. The fluid may be absorbed through the unbroken skin of rabbits in doses resulting in death, but again the minimum lethal dose is such that accidental massive skin exposures to man do not present a hazard. Skin and eye irritation studies with rabbits would classify the fluid as a mild irritant. Laboratory animals survived six-hour exposures to an atmosphere saturated with the vapors of the fluid. On the basis of this data, it is concluded that Pydraul AC requires no special handling precautions other than avoiding prolonged or repeated skin contact. Accidental splashing in the eyes will result in moderately severe pain and irritation but no permanent damage should result.

NVF 003572

TOXICITY OF PYDRAUL FLUIDS

Pydraul F-9

There has been considerable toxicity research on Pydraul F-9. Attached is a discussion and interpretation of the toxicity studies. The results are also summarized in a briefer fashion on page 18 of the enclosed Pydraul F-9 Technical Bulletin.*

Pydraul 625

The Oral LD₅₀ of 34.3 grams per kilogram when tested with rats, and the Oral Minimum Lethal Dose of 4.25 to 5.00 grams per kilogram when tested with rabbits indicate that Pydraul 625 may be classed as "relatively harmless" to slightly toxic" from the standpoint of oral ingestion. Potential irritation studies with rabbits show that it is only a mild irritant to skin and eyes. In acute vapor inhalation studies, rats survived a 6-hour exposure to atmospheres saturated with vapors of the product. The above figures are lower than those obtained in studies with Pydraul F-9. This comparison is significant since Pydraul F-9 has been used since 1949 with no reports of skin irritation or other toxic effects.

Pydraul 150

The toxicity report on Pydraul 150 indicates that it is practically innocuous when fed orally to rats since the animals survived single doses of 28.5 grams per kilogram with loss of appetite and severe diarrhea as the only toxic effects. The fluid apparently is not absorbed through the unbroken skin of rabbits since this species survived doses up to 9.5 grams per kilogram of body weight. In rabbit skin and eye irritation studies, Pydraul 150 was no more irritating than a 10% soap solution tested similarly. As indicated with Pydraul F-9, however, Pydraul 150 will cause severe pain if there is accidental splashing in the eyes of humans. Rats survived a 6-hour exposure to an atmosphere saturated with Pydraul 150 vapors.

Pydraul A-200

Our interpretation of the toxicity data obtained on this newer synthetic hydraulic fluid is that accidental ingestion is not a particular hazard in view of the high oral lethal dose (Oral LD₅₀: 10,500 mg/kg). Similarly, single massive skin exposures should not be immediately hazardous (Skin MLD: 625 to 1,250 mg/kg). The lethal dose following skin penetration is such, however, that prolonged and repeated skin contact

*This bulletin is out of print; see summary attached.

NVF 003573

Pydraul A-200 (Cont'd.)

should be avoided. Such exposure must also be avoided to prevent skin irritation. We also feel that vapor inhalation should be avoided when the fluid is at elevated temperatures. Such exposure again relates to prolonged or repeated exposures rather than massive or acute exposure. In the case of the latter, workmen would probably not voluntarily subject themselves to concentrations that are hazardous for short periods.

Pydraul AC

In animal toxicity studies with Pydraul AC, the oral lethal dose in rats is approximately 40 grams per kilogram and for rabbits, 3.5 to 4.5 grams per kilogram. The greater sensitivity of rabbits is typical of this type of fluid. This lethal dose is of such an order, however, that the fluid may be considered only "slightly toxic" to man from the standpoint of accidental ingestion of single oral doses. The fluid may be absorbed through the unbroken skin of rabbits in doses resulting in death, but again the minimum lethal dose is such that accidental massive skin exposures to man do not present a hazard. Skin and eye irritation studies with rabbits would classify the fluid as a mild irritant. Laboratory animals survived six-hour exposures to an atmosphere saturated with the vapors of the fluid. On the basis of this data, it is concluded that Pydraul AC requires no special handling precautions other than avoiding prolonged or repeated skin contact. Accidental splashing in the eyes will result in moderately severe pain and irritation but no permanent damage should result.

R. Emmet Kelly, M. D.
Medical Director
MONSANTO CHEMICAL COMPANY

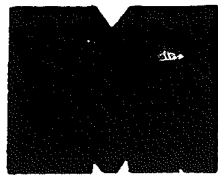
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The material in this report is to be used in development of the product and may be given to responsible sales contacts, but it is not to be used by them in advertising copy. The source of this material is not to be divulged until it appears in formal publications. No exceptions to the established rule may be made without the approval of the Medical Department in St. Louis. Customers' inquiries regarding matters of toxicity are to be referred as before to the Medical Department in St. Louis for reply.

--Monsanto Chemical Company

NVF 003574

File Pydraul



PYDRAUL F-9

for hydraulic equipment operating
near possible sources of ignition

FIRE-RESISTANT FLUID

equalling premium grade petroleum fluids
in lubricity, stability and service life.

NVF 003231

QUESTION:

WHY A FIRE-RESISTANT FLUID?

ANSWER:

FLUIDS SPRAY FARTHER THAN YOU'D THINK!

When a hydraulic system fails—and the best of them can fail—fluids at pressures of 1000 p. s. i. and above can jet surprising distances. In one disastrous fire a hydraulic line broke and the fluid was ignited by a flame 40 feet away.

The smaller the break, of course, the farther the fluid may travel. And through a pin-point leak, flammable fluids can be atomized to an explosive vapor-air mist—potentially an even greater hazard.

Around every hydraulic machine and line in your plant there is a danger zone.

ALSO . . . FLUIDS CAN BE IGNITED IN WAYS YOU'D NEVER SUSPECT.

In addition to obvious means—open flames, molten or red hot metals, electric sparks, etc.—there are many other ignition sources. One fire was started when a jet of flammable fluid broke an ordinary electric bulb and was ignited by the incandescent filament. Sometimes the source—like the maintenance man's welding torch—is only in the danger zone occasionally.

The safest way to guard against these dangers is to keep a fire-resistant fluid in your hydraulic system. And PYDRAUL F-9 is the preferred fluid.

PYDRAUL: Reg. U. S. Pat. Office. Monsanto trade-mark for fire-resistant industrial hydraulic fluid.

NVF 003232

Besides being **FIRE-RESISTANT**

PYDRAUL F-9 is a

TOP GRADE HYDRAULIC FLUID

excellent lubricity

Very high film strength and antiwear properties give component life equal to or better than that from premium oils.

high stability

Extreme resistance to heat, air and water means years of service life.

noncorrosive

No adverse effect on metals found in hydraulic systems.

water-free

A straight synthetic. Does not evaporate or require constant quality checks.

economical

Long service life. Can be reclaimed for use again and again.

safe to use

Both liquid and vapor are safe in industrial hydraulic operations. No special handling is required.

THE FIRE-RESISTANCE OF PYDRAUL F-9 HAS BEEN ATTAINED WITHOUT SACRIFICING ANY IMPORTANT HYDRAULIC FLUID SERVICE CHARACTERISTIC.

NVF 003233

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NVF 003234

Introduction

Hydraulic power is a vital and growing factor in our industrial picture. Its versatility and many advantages have led to its adoption by practically every industry.

Many of the applications of hydraulic power involve fire hazards such as open flames, molten metals and glass, sparks, etc. Since flammable petroleum fluids are widely used in hydraulic equipment, there have been serious fires when such fluids were accidentally released and ignited.

PYDRAUL F-9 was developed by Monsanto Chemical Company to provide industry with a fire-resistant hydraulic fluid which combines safety with the operational qualities of a premium grade petroleum fluid. This combination of safety and utility plus proved performance has brought wide acceptance of PYDRAUL F-9.

NVF 003235

Section I: Where Is PYDRAUL being used?

TYPICAL APPLICATIONS

The excellent performance record of *Pydraul F-9* has resulted in its use in a wide variety of equipment in

many industries. Following is a short list of typical applications in which *Pydraul F-9* is now being used.

Diecasting Machines
Hydraulic Presses
Furnace Tilters
Furnace Door Openers
Ingot Loaders
Furnace Regulators
Rotary Furnaces
Molten Salt Baths
Extrusion Presses
Forging

Plating Machines
Permanent Mold Casting
Injection Molding
Electric Furnaces
Elevators and Hoists
Hydromotors
Scarifiers
Stampers
Hydraulic Jigs
Compressor Lubrication

DIECASTING MACHINES

The final test of a hydraulic fluid is its use in a machine. *Pydraul F-9* is now being used in practically

all types of diecasting machines including those made by the following well-known manufacturers:

A-C Spark Plug Co.
H. & T. Engineering Co.
Cast-Master, Inc.
Cleveland Automatic Machine Co.
Cuyahoga Industries
Hydraulic Press Manufacturing Co.

Kux Machine Company
Lake Erie Engineering Corp.
Lester-Phoenix, Inc.
Lewis Welding and Engineering Co.
Reed Prentice Corp.
Schultz Diecasting Co.

HYDRAULIC PUMPS

The high film strength and excellent lubrication characteristics of *Pydraul F-9* make possible its use wherever a petroleum fluid of comparable viscosity can be used. *Pydraul* has been pumped at temperatures

over 200° F. and at pressures up to 10,000 p.s.i. Some of the commonly encountered hydraulic pumps in which *Pydraul F-9* is being used include the following:

Adel
Barnes
Denison
Hydraulic Press Manufacturing
Imo-De Laval
Northern

Oilgear
Racine
Roper
Tuthill
Vickers
Worthington

Pydraul F-9 was developed primarily for use in the diecasting and metals industries where hydraulics are used with hot metal. Its unique combination of

properties recommend *Pydraul F-9* for uses even more diversified than the current applications in which it has proved so successful.

Section II: Safety

During several years of industrial use *Pydraul* F-9 has been accidentally discharged over molten metal, red hot ingots, arcs, open flames and sparks. In no case has a fire resulted from such contact.

Most materials, even metals, can be made to burn under some conditions. If *Pydraul* F-9 is heated until decomposition products are formed, some burning can occur if an ignition source exists. But this is likely to happen only around high temperature sources like furnaces, molten metal, etc. Under conditions of industrial use, extraneous burning in hot areas is not

important because excessive heat has already been provided for. What is important is keeping flames from leaving such areas, thereby spreading fires. Thus a hydraulic fluid which is used in high temperature areas or which can reach these by line breaks, should not carry flames outside the high temperature zone. *Pydraul* F-9 excels in this important flame resistance.

Below are some of the test data which demonstrate the safety of *Pydraul* F-9 under conditions of industrial hydraulic operation.

TABLE I: Flammability Data

TEST	RESULTS
AUTOGENOUS IGNITION TEMPERATURE (ASTM Method D:286-30)	Greater than 1,100° F.
MOLTEN METAL IGNITION TEMPERATURE <i>Pydraul</i> F-9 was sprayed, dripped and flooded onto the surface of a molten alloy at approximately 1500° F.	Fluid did not flash or ignite.
HIGH-PRESSURE IGNITION TEST The mist from spraying <i>Pydraul</i> F-9 through a small orifice under 1,000 p.s.i. was subjected to the flame of an oxyacetylene welding torch.	Even when exposed to the hottest portion of the oxyacetylene flame (approximately 6,000° F.) the fluid did not flash or ignite.
HOT MANIFOLD TEST <i>Pydraul</i> F-9 was dripped onto the surface of a hot manifold.	Did not burn at 1,300° F., nor when the surface temperature was increased to 1,475° F., the limit of the equipment.
ARC IGNITION TEST <i>Pydraul</i> F-9 was sprayed through a 1/8" petcock at varying pressures up to 200 p.s.i. through a carbon arc that had a free arcing distance of approximately 1 1/2".	At no time was a flash observed, nor did the fluid burn.
STATIC CARBON ARC TEST A metal pan was filled to a fluid depth of approximately 3/4" and the arc struck between the electrode and the bottom of the pan, passing through the fluid. The arc was sustained for approximately 30 seconds during which time the carbon electrode became white hot.	No flash was observed, nor did the fluid burn.

Independent Tests Conducted by Factory Mutual Laboratories resulted in the following report:

"On the basis of these tests and ones previously conducted with petroleum base hydraulic oils and other types of less hazardous fluids, we consider that *Pydraul* F-9 fits into the category of acceptable less hazardous fluids."

(Factory Mutual Laboratories)

Section III: General properties of PYDRAUL F-9

TYPICAL ANALYSIS OF PYDRAUL F-9

Appearance:	Amber, oily liquid	Neutralization Number (mg. KOH/gm.):	0.1
Odor:	Mild, pleasant	Pour Point:	-5° F.
Specific Gravity:	1.27 at 75° F.	Viscosity Index:	+32
Pounds Per Gallon:	10.56 at 75° F.	Viscosity:	
Flash Point (C.O.C.):	430° F.	100° F.	222 S.U.S. or 48 cps.
Fire Point (C.O.C.):	675° F.	210° F.	44.4 S.U.S. or 5.56 cps.

OTHER PROPERTIES

Specific Heat:	Temperature	cal./gm./° C. or BTU/lb./° F.
	23° C. (73.4° F.)	0.31
	59° C. (138.2° F.)	0.33
	107° C. (224.6° F.)	0.36
	(Specific Heat = $0.2959 + 6.28 \times 10^{-4}t$)	
Thermal Conductivity:	Temperature	cal./cm./° C./sec.
	28° C.	27.5×10^{-8}
	81° C.	26.6×10^{-8}
Coefficient of Thermal Expansion:	0.00041/° F. between 80° F. and 400° F.	
	0.00073/° C. between 25° C. and 200° C.	
Bulk Modulus:	387,000 p.s.i. (room temperature, between 1000 and 6000 p.s.i. applied pressure)	
Compressibility:	2.58×10^{-6} sq. in./lb.	
Solubility of PYDRAUL F-9 in water:	Negligible	
Solubility of Water in PYDRAUL F-9:	0.2% at 75° F; 0.6% at 210° F.	
Miscibility:	Completely miscible with oil, with 10-15% of tricresyl phosphate. Does not mix with water.	
Surface Tension:	32 dynes/cm.	
Specific Resistivity:	0.15×10^8 Megohm-cm.	
Dielectric Constant:	6.25 at 1000 cps. and 25° C.	
Dissipation Factor:	at 60 cps. = 32.9% at 1000 cps. = 2.2%	
Dielectric Strength:	33 KV (1 sq. cm. electrodes)	

FIG. 1: Specific Gravity of PYDRAUL F-9, 60°—300° F.

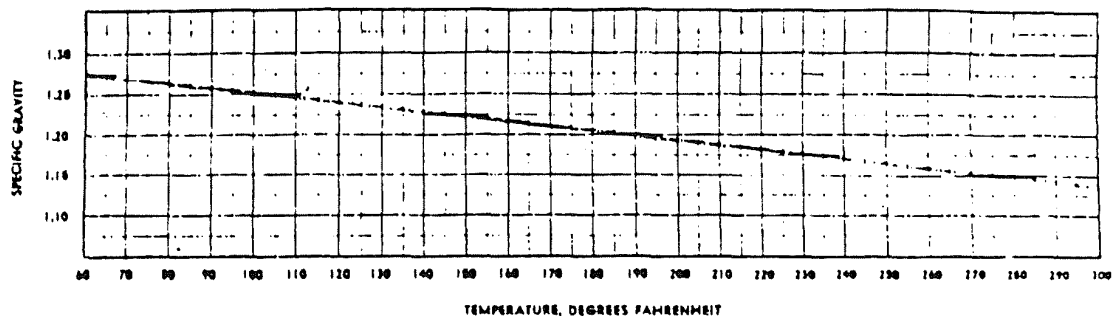
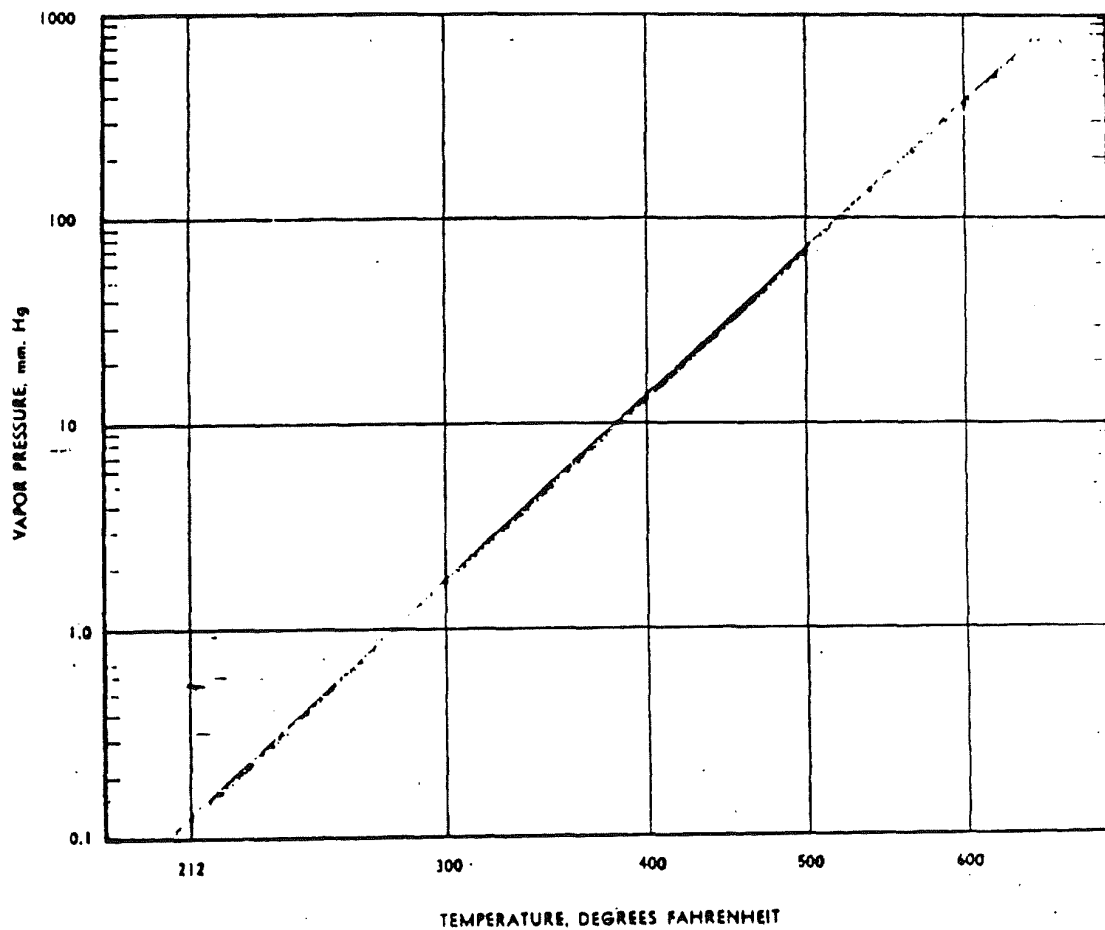
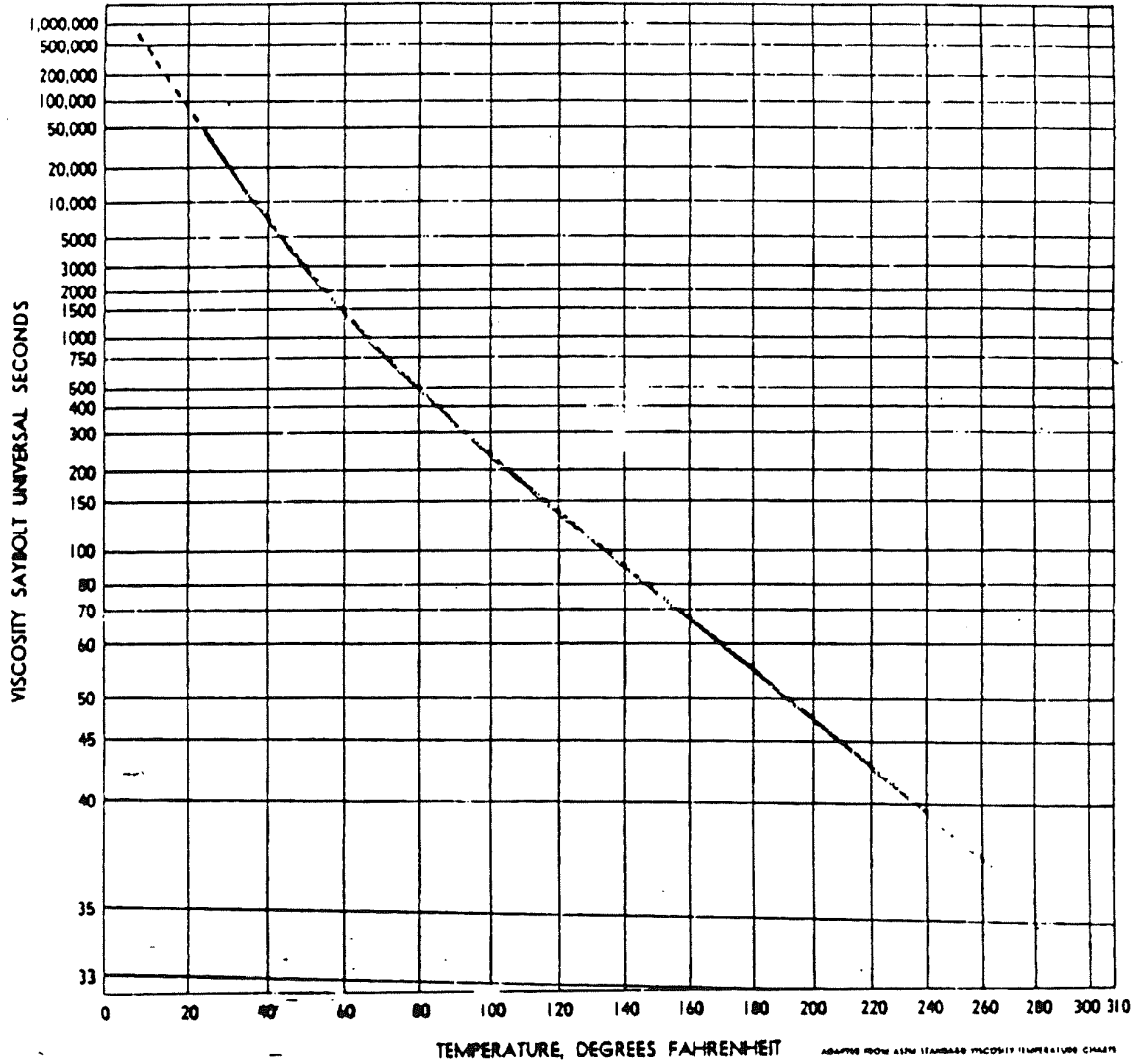


FIG. 2: Approximate Vapor Pressure of PYDRAUL F-9



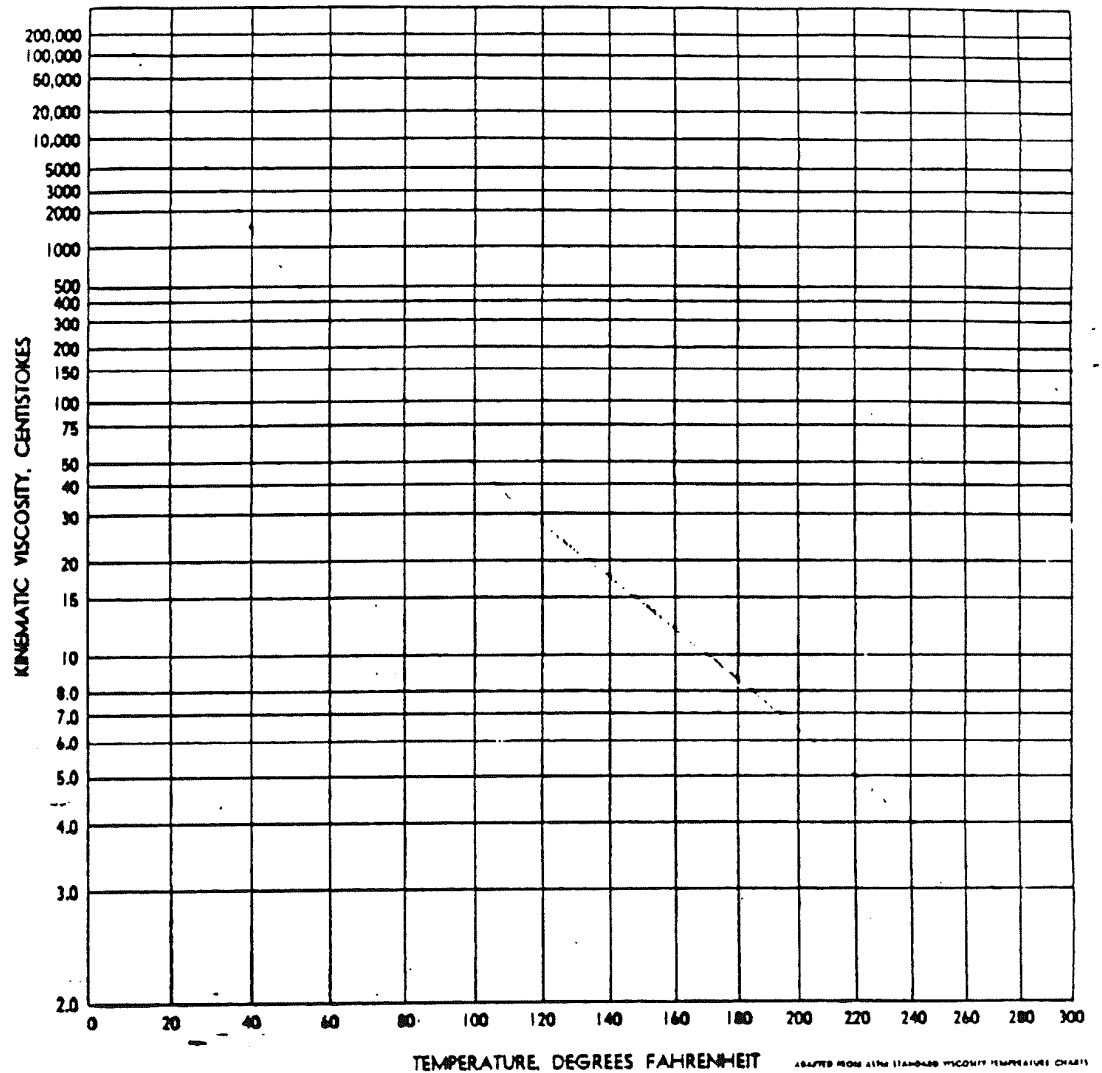
NVF 003239

FIG. 3: Saybolt Viscosity of PYDRAUL F-9



NVF 003240

FIG. 4: Kinematic Viscosity of PYDRAUL F-9



NVF 003241

Section IV: Stability of PYDRAUL F-9

Pydraul F-9 is a highly stable fluid under all normal conditions of industrial hydraulic use. It has excellent resistance to heat, water and oxygen, and is noncor-

rosive to metals. Examination of *Pydraul F-9* after several years of use has shown that the fluid retains its desirable properties almost indefinitely.

THERMAL STABILITY

The fire resistance of *Pydraul F-9* is inherent and is not due to the presence of water or other additives. *Pydraul F-9* contains no readily volatile components, the loss of which can alter fluid composition during

use, nor does it break down under temperatures encountered in most systems. Where necessary, *Pydraul F-9* can be operated for long periods of time at temperatures as high as 300° F.

CORROSION AND OXIDATION STABILITY

Pydraul F-9 does not react with the various metals found in hydraulic systems nor does it allow electrolytic corrosion. Good oxidation stability is to be expected due to the fire-resistant nature of *Pydraul F-9*, since burning is simply rapid oxidation.

The following tests were run according to procedures for determining corrosion and oxidation stability as

given in the Military Specification MIL-O-5606 (Oil Hydraulic, Aircraft, Petroleum Base). In this procedure, strips of copper, iron, magnesium, aluminum and cadmium plated steel are all immersed in the test fluid. The fluid is heated to 250° F. and held there for 168 hours while air is bubbled through. The fluid and metal strips are then examined for changes.

TABLE 2. Results of Corrosion and Oxidation Stability Tests of PYDRAUL F-9 by Specification MIL-O-5606

Property	Initial Value	Final Value	Actual Change	Change Allowed by Specification
Viscosity at 130° F. (Centistokes):	20.9	20.4	-2.4%	-5 to +20%
Neutralization No.:	0.03	0.00	-0.03	+0.20
Fluid Evaporation:		1.32%	1.32%	8.0%
Fluid Separation:		None	None	None
Effect on Metals:				
<u>Metal</u>	<u>Wt. Change (mg./cm.²)</u>		<u>Allowable Wt. Change</u>	<u>Visual Examination</u>
Copper	-0.08		±0.60	Light coating
Iron	+0.01		±0.20	Light coating
Aluminum	+0.04		±0.20	Light coating
Magnesium	+0.05		±0.20	Light coating
Cadmium/Steel	-0.03		±0.20	Light coating

NVF 003242

HYDROLYTIC STABILITY

In Military Specification MIL-F-7100, 25 grams of water and 75 grams of test fluid are placed in a beverage bottle along with a strip of pure copper. The bottle is capped and rotated end-over-end for 48 hours at 200° F. The liquids and metal are then observed for changes.

**TABLE 3: Hydrolytic Stability of PYDRAUL F-9
by Specification MIL-F-7100**

Property	Initial Value	Final Value	Actual Change	Change Allowed by Specification
Viscosity at 130° F., Centistokes:	20.91	20.13	-3.7%	-5% to +15%
Acidity:				
Fluid Layer (Neut. No.)	0.08	0.08		+0.5
Water Layer (total acidity, mg. KOH)		2.25	2.25	+10.0
Wt. Change of Copper (mg./cm. ²):		-0.05	-0.05	±0.50
Sludge:		0.0016 gm.	+0.003%	+0.5

NVF 003243

Section V: Lubrication and pump tests

An essential characteristic of a hydraulic fluid is the ability to properly lubricate moving parts under critical loading. *Pydraul F-9* is outstanding in this respect, and field use has shown that in some instances it has reduced wear even below that encountered with high grade petroleum base fluids.

Pydraul F-9 has been tested and used in most of the hydraulic pumps commercially available. Pump manu-

facturers have expressed their approval of *Pydraul F-9* because its characteristics help their pumps attain maximum service life. *Pydraul F-9* is even being used successfully in pumps where normally a petroleum fluid of much higher viscosity would be required.

Results of some of the laboratory and field tests on the lubricating characteristics of *Pydraul F-9* follow.

TABLE 4: Shell Four Ball Wear Test

Metals and Load	Average Scar Diameter in Millimeters	
	With Premium Grade Hydraulic Fluid	With <i>Pydraul F-9</i>
Steel on Steel		
1 Kg.	0.198	0.155
10 Kg.	0.226	0.250
40 Kg.	0.799	0.696
Steel on Bronze		
1 Kg.	0.964	0.299
10 Kg.	1.730	0.578
40 Kg.	2.710	1.080

Timken Extreme Pressure Test:

OK load = 50 lbs.

Film strength = 17,500 p.s.i.

Almen Wear Test:

Weight loss at 4000 p.s.i. bearing load — 2.0 mg.
(Approximately equivalent to SAE 10 lubricating oil)

NVF 003244

[PUMP TESTS

Vickers Vane Pump, Type V-105A

Two parallel tests were run using *Pydraul* F-9 in one pump and a standard petroleum base hydraulic fluid in the other.

During the test, the pumps were operated at 150° F. ($\pm 5^\circ$) for 16 hours a day, 5 days a week. This interrupted operation was deemed more stringent than 24-hour operation because of the greater wear to be expected from frequent cold starts. For the first 400 hours, both pumps operated at 1200 r.p.m. at 100 p.s.i. delivering 4.76 gallons per minute. After 400 hours, the pump handling *Pydraul* F-9 was stepped up to 1500 p.s.i. for 126 hours; then for the next several hundred hours to 1800 r.p.m. at 1500 p.s.i. delivering 6.5 to 7.0 gallons per minute. After 800 hours of total operation, the pump was dismantled and the parts checked for weight loss.

After only 200 hours of operation the rotor of the pump operated on petroleum fluid showed a weight loss of 2.9 grams due to wear. The rotor with *Pydraul* F-9 lost no weight in the first 200 hours, and only 0.1 gram after 800 hours. The weight loss of vanes and rings with either fluid was negligible.

Vickers Piston Pump, Type PV 2008

This pump was tested with *Pydraul* F-9 at 2000 p.s.i. for 1118 hours, and the parts were inspected. *Pydraul* F-9 was judged quite suitable for this type of pump.

In numerous field installations the service life of the above two pumps operating with *Pydraul* F-9 ranges between 25,000 and 40,000 hours—equivalent to the service with premium petroleum fluids.

Laboratory and field tests have been made on the pumps of other manufacturers with equally good results. For a list of the pumps in which *Pydraul* F-9 is now being used see page 2.

NVF 003245

Section VI: Change-over to PYDRAUL F-9

The conversion to *Pydraul F-9* of equipment which has previously contained petroleum or other hydraulic fluid is relatively simple and follows logical engineering practice. The steps below are given simply as a check list. Where possible, it is desirable to obtain recommended procedures from the manufacturers of the machine and pump on hand since the makers will be most familiar with the best method of handling their own equipment.

Pydraul F-9 is an excellent flushing compound in its own right: it will loosen tars, varnish and residues left by the previous fluid. *Pydraul F-9* will also loosen and remove paint from the interior of the machine. These contaminants can be most easily removed from

the circulating *Pydraul F-9* by a filter in the system. If there is no filter, or if it is difficult to reach for cleaning, it may be advisable to use a portable filter which can be connected into the fluid return line. This portable filter can be left in the line for two or three days of operation and then moved to the next machine to be converted. Since it is considered good hydraulic practice to filter hydraulic fluids during normal operation, the portable filter can be used routinely, after conversion, to filter the fluids on a regular basis.

Following are the general steps for converting a hydraulic system to *Pydraul F-9*.

1. Before shutting down the machine for conversion, *check* the entire system while in operation for fluid *leaks*. Mark these for correction later.
2. *Drain* the previous fluid from the reservoir, lines and cylinders as completely as possible. Sometimes this can be done by opening unions at low spots in the system, and in other cases blowing out with air will help.

If the previous fluid was petroleum oil it will mix readily with *Pydraul F-9*. However, *the more completely the oil is drained, the safer the new fluid will be.*
3. Clean the *reservoir* carefully and completely. It is desirable to remove interior paint at this time if possible, and this can be done by scraping or with a commercial paint remover. When the reservoir is clean it should be wiped dry with clean rags or towels that are free from dirt or grit. Waste is likely to contain grit particles and tint that will later damage the pump or valves.
4. If a *filter* is used, remove and clean or change the cartridge.
5. Check the *pump assembly* and replace any parts that are seriously worn.
6. As to *packings*, either of two courses may be followed. Many have converted with no change in packings and then have later replaced leaking packings, if any, with resistant materials. The other method is to change part or all of the packings to materials resistant to *Pydraul F-9* at the time of conversion. Neoprene, a commonly used packing, swells in *Pydraul F-9*. In static or fixed packings this is no problem since the swelling usually makes a tighter seal. However, when the joint is later dis-assembled the swelled

packing usually has to be replaced with a new one.

For dynamic or sliding seals, a neoprene part is more likely to fail and these moving seals should be replaced with packings made of resistant materials. (Most packing manufacturers can now supply packings for use with *Pydraul F-9*. If the regular supplier does not have these, a list of manufacturers is shown in Section VII.)

7. In most machines, if *hose* is used, it is usually of neoprene. In previous installations, this hose has apparently presented no problem. Swelling does not seem to occur nor have there been failures other than from normal wear. However, it is recommended that when hose is replaced, a hose resistant to *Pydraul F-9* (Butyl lining will suffice) should be used.
8. If a nitrogen bottle *accumulator* is used, no change is necessary. If a bladder type accumulator is used, a Butyl rubber bladder should be used instead of neoprene.
9. *Reconnect* all lines and tighten, particularly those joints previously noted leaking. Fill with *Pydraul F-9* to the proper level.
10. With the hydraulic controls on neutral, *start and stop* the pump several times, without allowing the system to reach working pressure. This will provide the necessary pump lubrication. The pump may then be left on and the system brought up to working pressure.
11. *Run through* the cycle several times to use all parts of the hydraulic system. Bleed the air through the petcocks or valves provided from any parts in which air can collect.
12. Check the *fluid level* and add *Pydraul F-9* if necessary.

NVF 003246

About Fluid Makeup . . .

The technique of holding down the makeup requirement for *Pydraul F-9* is the same as with any fluid; namely, *adequate maintenance*. The normal loss of *Pydraul F-9* in a properly converted system will be no more than that for a petroleum fluid, and in a great many cases it has been considerably less. With proper maintenance *Pydraul F-9* losses in *diecasting* machines have been held to as little as a pint per 8 hour shift. If a fluid reclaiming system is added—a relatively simple matter with *Pydraul F-9*—the total use of fluid can be cut even further. It is not unusual to find that where *Pydraul F-9* has been installed, the daily cost of hydraulic fluid used has *actually gone down*.

1. CHECK LEAKS

2. CHECK FLUID

3. EXHAUST OLD FLUID

4. FILL WITH NEW FLUID

5. CHECK & REPAIR

6. MAINTAIN FLUID

7. ADDITION FILTER

8. CHECK FLUID

9. SHUT OFF FLUID

10. CHECK FLUID

11. CHECK FLUID

12. CHECK FLUID

Section VII: Packings and seals data

Packings and seals suitable for use with *Pydraul* F-9 are available from a large number of manufacturers and in all configurations. No "special" materials are needed for packings or seals — simply certain kinds of standard materials.

Packings resistant to *Pydraul* F-9 are generally required only for moving (dynamic) seals. Static seals may be made of resistant materials or not, as the user

prefers. In a static packing, swelling usually gives an even tighter seal. Best practice, however, dictates replacement of nonresistant seals with suitable packings during normal maintenance and routine overhaul.

Table 5 lists the manufacturers who have indicated the availability of packings resistant to *Pydraul* F-9.

TABLE 5: Packings Reported Suitable For Use With PYDRAUL F-9

Supplier	Type and Designation	"O" Rings	"V" Rings	"U" Packings	Flat Gaskets	Oil Seals	Back-up Rings	"U" Cups	Flange Packings	Other
Acushnet Process Co. New Bedford, Mass.	Silicone: SCX-2286	X	X	X	X	X			X	
Anchor Packing Co. 401 N. Broad St., Philadelphia, Pa.	Silicone AP-1 Teflon #450 Hydroil Impregnated Duck Impregnated Asbestos	X		X	X		X			X
Chicago Rawhide Mfg. Co. 1301 Elston Ave., Chicago 22, Ill.	Sirvene		X	X	X	X	X	X	X	X
Crane Packing Co. 1800 Cuyler Ave., Chicago 13, Ill.	Butyl: 3332 Butyl: 3342 Teflon: Chemlon Vegetable Fiber	X								
Dow - Corning Corp.* Midland, Michigan	Silicone: 50, 80, 152, 250 7-170, 8-170, 8-164, 675	X	X	X	X	X		X	X	X
Garlock Packing Co. Palmyra, New York	Silicone: 9471, 9034 Silicone: 8859 Silicone: 8773, 9478 Butyl: 9188, 8783 Asbestos: 900, 950 Impregnated Duck: 7857, 7059 Teflon	X		X	X			X	X	X
General Electric Co.* Waterford, New York	Silicone: SE 450, SE 360	X	X	X	X	X		X	X	X

Goshen Rubber Co. P. O. Box 517, Gosben, Ind.	Silicone: S-1219	X		X	X	X		X	X	X
Graef Engineering Co. P. O. Box 416, Paramount, Calif.	Teflon, Kel-F	X					X			X
Greene, Tweed, & Co. North Wales, Pa.	Butyl: 190	X	X	X	X			X	X	X
International Packing Co. Bristol, New Hampshire	Silicone: L 85-1 Butyl: P 64-2 Leather: KK104A, LA-7	X	X	X	X	X			X	X
Kirkhill Rubber Co. Brea, Calif.	Butyl: 670-X-682D & 670-X-682G Silicone: 950-Y-343 & 970-A-185	X	X	X	X	X				X
Linear, Inc. State Road & Levick St., Philadelphia, Pa.	Butyl: PAA-70 Butyl: PAB-85 Impregnated Duck: 865	X	X	X	X			X	X	X
National Motor Bearing Co. 11634 Patton Rd., Downey, Calif.	Butyl: L-14	X								
Parker Appliance Co. 17325 Euclid Ave., Cleveland 12, Ohio	Silicone: 2082-1	X	X	X		X		X	X	X
Plastic & Rubber Products Co. 2100 Hyde Park Blvd., Los Angeles 47, Calif.	Butyl: 805-70	X						X		
Precision Rubber Products Co. 3110 Oakridge Drive, Dayton 7, Ohio	Butyl: 907-70	X								
Raybestos-Manhattan Packing Div. Manheim, Pa.	Asbestos-Neoprene: K-68 Teflon		X	X	X			X	X	X
W. S. Shamban Co. 11617 W. Jefferson Blvd., Culver City, Calif.	Teflon, Kel-F, Nylon Polyethylene	X	X	X	X		X	X	X	X
Stillman Rubber Co. 5811 Marilyn Ave., Culver City, Calif.	SR 602-A-70	X						X		X
United States Gasket Co. Camden 1, New Jersey	Teflon, Kel-F	X	X	X	X	X	X	X	X	X
United States Rubber Co. Rockefeller Center, New York 20, N. Y.	Butyl: I-8728 Asbestos-Teflon: 135 Asbestos-Neoprene: 19069 Butyl: L-14				X					X
Vellumoid Co. Rockdale St. & Beaman Ave., Worcester 6, Mass.	Vellumoid	X								

• (Supplier of silicone stock only. Packings are supplied by a number of packing manufacturers.)

Section VIII Other hydraulic components

Filters, hose, couplings and other hydraulic system components for use with *Pydraul F-9* are readily available. Often these are the same units that are used with petroleum fluids. Paints resistant to *Pydraul F-9* can be supplied by several manufacturers.

Manufacturers who have reported having suitable components for use with *Pydraul F-9* are listed below.

FILTERS

Standard oil filters can usually be used satisfactorily. Earth type filters are also suitable where excessive quantities of moisture are not present. Manufacturers of such filters include—

Briggs Filtration Co.	Hilliard Corp.
Capital Engineering Co.	Honan-Crane Corp.
Cuno Engineering Corp.	Marvel Engineering Co.
Dollinger Corp.	

HYDRAULIC HOSE

Although both neoprene and Buna N type rubber swell in *Pydraul F-9*, hoses of both materials have been used widely and are apparently satisfactory. In practice it would probably be preferable to use a more resistant rubber such as Butyl if new hoses are to be installed. Those supplying hose lined with Butyl rubber include—

Aeroquip Corp.	Electric Hose & Rubber Co.
Anchor Coupling Co.	Resistoflex Corp.
B. F. Goodrich Co.	Weatherhead Corp.
Eastman Manufacturing Co.	

SWIVEL COUPLINGS

Pydraul F-9 is being used satisfactorily in systems containing swivel couplings supplied by such companies as—

Barco Mfg. Co.	Chicksan Co.
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PIPE JOINT SEALERS

The following products have been reported satisfactory as sealing compounds for pipe joints:

John Crane Plastic Lead Seal No. 2; Crane Packing Co., Chicago, Illinois.
Glyptal 1201 Red Enamel; General Electric Co., Schenectady, N. Y.
Permatex Special Sealant No. 1282; Permatex Co., Brooklyn 35, New York.
Silastic 6127 Putty; Dow Corning Corp., Midland, Mich.

Epon Adhesive VI; Shell Chemical Co., New York 36, N. Y.

ACCUMULATORS

Hydraulic accumulators are found on many systems and in some of these a bladder is used to separate the fluid from the air pressure system. A Butyl rubber bladder is necessary with *Pydraul F-9*.

Companies supplying satisfactory accumulators include—

Greer Hydraulics, Inc. Superior Pipe Specialties Co. Hydramotive, Inc.

HEAT EXCHANGERS

Many hydraulic systems, particularly on diecasting machines, use a heat exchanger (oil cooler) to control fluid temperature. These exchangers are metal and can be used with *Pydraul F-9* quite satisfactorily. Standard thermostats are also compatible with *Pydraul F-9*.

PAINTS

The following paints have been recommended by their manufacturers as being satisfactory for use with *Pydraul F-9*:

Amercoat Corp., South Gate, California: Amercoat #77.
Andrew Brown Co., Irving, Texas: Chemical Resistant Enamel.
Carboline Co., St. Louis 19, Missouri: Phenoline 300, Phenoline 305 (Gray and orange available. Other colors available on order).
E. I. du Pont de Nemours & Co., Kansas City 11, Missouri: Crankcase Sealer 681-8004, Buff Enamel C-100-X-71680.
Finch Paint & Chemical Co., Torrance, California: Cat-A-Lac Primer #454-1-1, Cat-A-Lac Top Coat.
W. P. Fuller & Co., Los Angeles 54, California: 162-Y-63 Primer, 172-A-54 Aluminized Finish Coat, 173-W-57 White Coat Finish, 173-K-55 Sea Blue Finish Coat, 173-B-51 Black Finish Coat. (Other colors available on order.)
Lowe Brothers Co., Dayton 2, Ohio: Thermo Spravinl Finish.
Pittsburgh Plate Glass Co., Milwaukee 1, Wisconsin: Chemical Resistant Enamel 66442.
Rinshed Mason Co., Anaheim, California: H-4537 Red.

Section IX: Reclaiming PYDRAUL F-9

The exceptional stability of *Pydraul F-9* and its resistance to water makes possible its recovery from leaks and spills. Careful recovery can result in considerable savings in the cost of the fluid. Therefore fluid recovery should be a definite part of the maintenance program where fluid losses are appreciable. *Pydraul F-9* can be readily reclaimed by removing the usual contaminants in two steps: separation of the water, and filtration of the dirt.

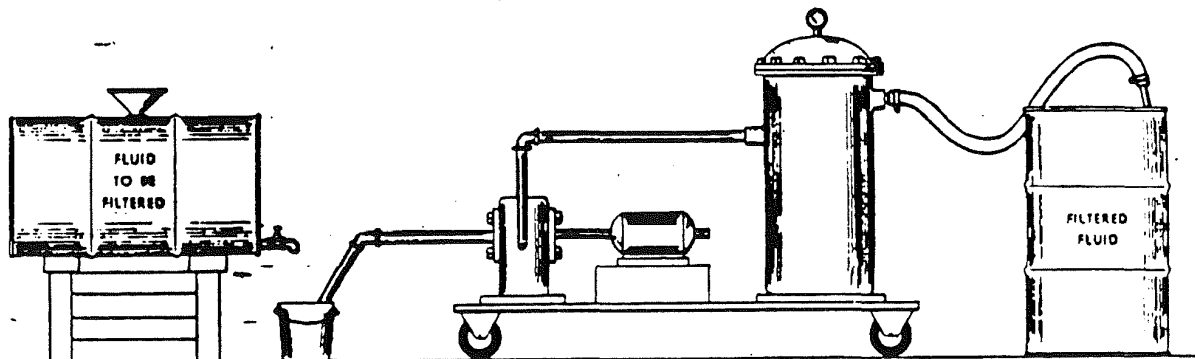
Since water is not soluble in *Pydraul F-9* it can be easily separated by allowing contaminated fluid to stand until two layers form — water on top and *Pydraul F-9* on the bottom. In the shop a drum can be reserved for collecting contaminated fluid. A drum with a side and end bung supported horizontally on a cradle about two feet above the floor is a simple and effective settling chamber. With the drum turned so the side bung is on top, salvaged fluid can be added through a large funnel left in the top opening. A drain valve in the end opening can then be used to periodically remove separated *Pydraul F-9* for filtration. More elaborate methods using this same principle might use settling tanks with sight gauges and so on.

Another method of separating water from *Pydraul F-9* involves the use of a centrifuge ("cream separator"). Suitable units are manufactured by De Laval and Sharples Co., among others. The advantages of the centrifuge are that large volumes of fluid can be processed rapidly and no settling-out period is necessary.

One caution should be noted. Oil will dissolve in *Pydraul F-9* and cannot be removed. This will not harm the *Pydraul F-9* but will increase fluid flammability and may affect packings. To maintain a fire-resistant fluid, contamination with oil should be avoided.

The final step is that of filtration and this can be done in any one of a number of commercial units. Filtering media such as cotton linters, felt, metal screens, etc. can be used and Fuller's earth and diatomaceous earth are satisfactory if water is not allowed to enter with *Pydraul F-9*. A small pump and motor are used to pick up the *Pydraul F-9* after separation from the water, force it through the filter, and then into the drum for storage. Care, of course, should be taken that the final drum is clean. A salvage drum, portable filter unit and storage drum are shown in Fig. 5. Fig. 6 is a diagram of a typical

FIG. 5: Diagram of Filter Apparatus



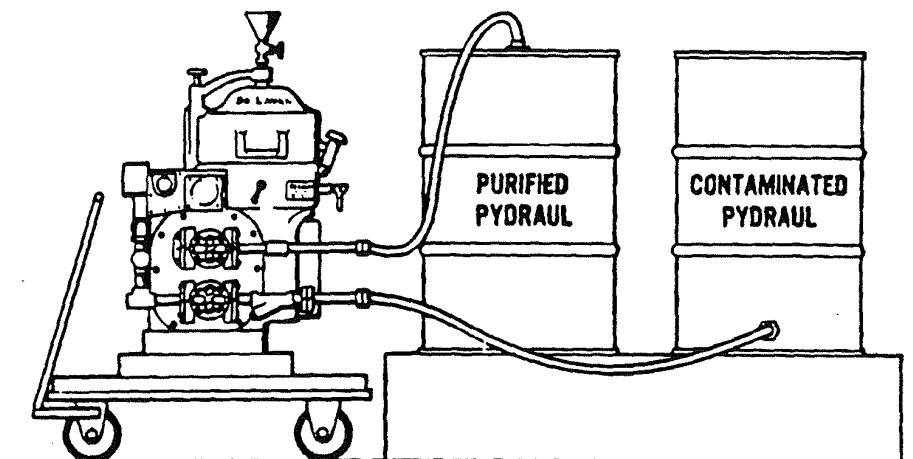
NVF 003251

centrifuge unit for water separation. Centrifuged fluid which still contains dirt has to be filtered as in Fig. 5.

Several of the filter manufacturers put out a complete unit that includes the filter, motor and pump. These companies include Hilliard, Cuno, and Honan-Crane. Such a unit has value beyond its use for reclaiming *Pydraul* F-9, as some plants use such equipment to clean up all their hydraulic fluid every few weeks. For other filter manufacturers see page 16.

The quantity of *Pydraul* F-9 that can be reclaimed is usually surprising. Simply placing containers beneath leaks until they can be repaired can result in fluid savings of 10% or more. Where drip pans have been used beneath hydraulic machinery more than 50% of the *Pydraul* F-9 purchased has been reclaimed. Savings like these greatly reduce overall fluid cost and can make *Pydraul* F-9 the most economical fire-resistant fluid in actual use.

FIG. 6: Diagram of Portable De Laval Centrifuge and Fluid Tanks



Section X: Toxicity and safe handling information

Extensive animal experimental work has been done on *Pydraul* F-9. In the case of oral feedings it was found that the minimum lethal dose for rats was 10.6 to 15.8 grams per kilogram of body weight. In rabbits the oral MLD was 0.57 to 0.85 grams; in both cases the undiluted material was introduced into the animal stomach by means of a rubber tube catheter.

Pydraul F-9 was patch-tested full strength according to the method of Schwartz and Peck, which is the standard test for industrial chemicals. Two hundred and five volunteers were tested and there was no evidence of primary skin irritation or sensitization.

The material was tested for its vapor phase toxicity by exposing animals to saturated atmosphere concentrations in suitable chambers. This part of the investigation involved not only the vapors of *Pydraul* F-9 itself but also experiments where the fluid was dropped on Inconel surfaces heated to 1050° F. and 1250° F. In all cases the toxicity was roughly com-

parable to that of petroleum-based hydraulic fluids as far as short-term massive exposures are concerned.

When splashed or sprayed into the eyes, *Pydraul* F-9 causes burning and smarting; however, there have been no reports of lasting damage. In treating eye irritation following introduction of *Pydraul*, copious and prolonged washing is recommended. To relieve the irritation, physicians have used 1% pontocaine solution as well as ophthalmic cortisone acetate solution.

Regarding the effect of *Pydraul* F-9 on workers, we have not experienced any injuries during its manufacture. We advise in safe handling that following prolonged or repeated skin contact, the material be washed off and that the material be kept out of the eyes. If prolonged contact with the decomposition products at elevated temperatures should occur, respiratory protection is necessary. For short periods such as would occur in turning off a machine following a breakdown, no such protection is necessary.

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AVAILABILITY

Pydraul F-9 is readily available and is supplied in 5 gallon cans, 53 gallon steel drums, tank trucks and tank cars. It is manufactured under strict quality control from materials in dependable supply. Test samples are available. Contact your nearest Monsanto sales office for further information.

SHIPPING INFORMATION

Shipping Classification in U.S.A.—Chemicals, NOIBN

Shipping Regulations —None

SALES OFFICES

MONSANTO CHEMICAL COMPANY

Organic Chemicals Division

800 North 12th Blvd.

St. Louis 1, Missouri

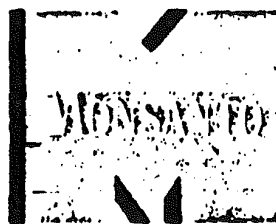
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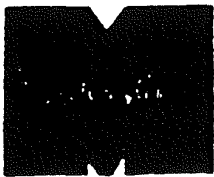
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PYDRAUL F-9...

***tallor - made
straight synthet
fire-resistant
hydraulic fluid***

After a successful test program, Monsanto introduced Pydraul in 1951 as industry's first tailor-made straight synthetic fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged; today, Pydraul F-9 is still considered the basis for comparison.

Most of the 500,000,000 machine hours Pydraul fluids have served industry have been accumulated on Pydraul F-9. Pydraul F-9 is now in use in every major type of die-casting machine plus a wide variety of other types of equipment found in the metal working industry. Pydraul F-9 is the most performance-proven fire-resistant fluid now in use in industrial applications.

NVF 003310

*Pydraul, Monsanto trademark. Reg. U.S. Pat. & Tm. Off.

PYDRAUL F-9 HAS DOUBLE-ACTION FIRE RESISTANCE...

Pydraul F-9 protects equipment and personnel in the event of contact with ignition sources and remains fire resistant in use . . . contains no water to evaporate and leave a flammable residue. During its long use by industry, Pydraul F-9 has been accidentally discharged over molten metal, red-hot ingots, arcs, open flames and sparks . . . without causing fire. Pydraul F-9 has never caused or contributed to hydraulic fire in any type of equipment. Pydraul F-9 is the only fire-resistant hydraulic fluid to be listed by Underwriter's Laboratories.

Here are the results of the important laboratory tests for fire resistance:

HOT MANIFOLD TEST (per MIL-F-7100) Pydraul F-9 exposed to the surface of a manifold, 1300° F.	FLUID DID NOT FLASH OR IGNITE
HIGH-PRESSURE IGNITION TEST (AMS-31508, 4.9.3.2; and MIL-F-7100) Pydraul F-9 sprayed through a small orifice at 1000 psi, passing through the flame of an oxyacetylene torch, 6000° F.	FLUID DID NOT FLASH OR IGNITE
LOW-PRESSURE SPRAY TEST (AMS-31508) Pydraul F-9 sprayed through an orifice at low pressure, the mist passing over an ignited oil-soaked rag.	FLUID DID NOT INCREASE INTENSITY OF FLAME
MOLTEN-METAL IGNITION TEST Pydraul F-9 poured on the surface of a molten alloy, exceeding 1100° F.	FLUID DID NOT FLASH OR IGNITE

PYDRAUL F-9 IS PERFORMANCE PROVEN...

Pydraul F-9 has compiled an excellent performance record in a wide variety of equipment in many industries. This list shows typical applications.

DIECASTING MACHINES	MOLTEN-SALT BATHS	ELECTRIC FURNACES
HYDRAULIC PRESSES	EXTRUSION PRESSES	ELEVATORS AND HOISTS
FURNACE FILTERS	FORGES	SCARFERS
FURNACE-DOOR OPENERS	PLATING MACHINES	STAMPERS
INGOT LOADERS	PERMANENT MOLD CASTING	HYDRAULIC JIGS
ROTARY FURNACES		

Its unique combination of properties recommend Pydraul F-9 for uses even more diversified than the current applications in which it has proved so successful.

PYDRAUL F-9 HAS PREVENTIVE-MAINTENANCE PROPERTIES...

Pydraul F-9 is known throughout industry for its quality and dependability . . . wherever machines have been converted from water based fluid to Pydraul F-9, users report maintenance tasks drop off sharply. The reason is this: Pydraul F-9 was especially designed to give the excellent performance of a premium petroleum oil with the added protection of fire resistance. These properties of Pydraul F-9 make it a true preventive-maintenance fluid . . .

OUTSTANDING STABILITY	Pydraul F-9 doesn't wear out in use. Systems have operated on Pydraul F-9 since it was introduced in 1951 without a single fluid change . . . you don't have to inspect it monthly or plan any fluid changes other than normal make-up requirements.
PREMIUM LUBRICITY	Pydraul F-9 has exceptional film strength and load-carrying capacity. In this respect, it outperforms even the best petroleum oils. Parts show very little wear when operated on Pydraul F-9.
GOOD ANTIRUST PROPERTIES	Pydraul F-9 does not cause rusting of metals, does not lose antirust properties with use.
NONTHICKENING	Pydraul F-9 does not thicken or form sludge with use. Pydraul F-9 systems run cleaner than even those on premium petroleum oil.

NVF 003311

Timken Load (Passing)

45 lbs., 18,000 psi

Almen Wear

2.0 mg. at 4000 psi

Almen Load

48 lbs., 25,000 psi

Steel-on-Steel

Steel-on-Bronze

10 Kg.

40 Kg.

10 Kg.

40 Kg.

0.28

0.62

1.18

1.28

PYDRAUL F-8 SPECIFICATIONS

Cloudy liquid

1.270 - 1.300

Add, 0.15 maximum

0.20% maximum

PYDRAUL F-8 TYPICAL PROPERTIES

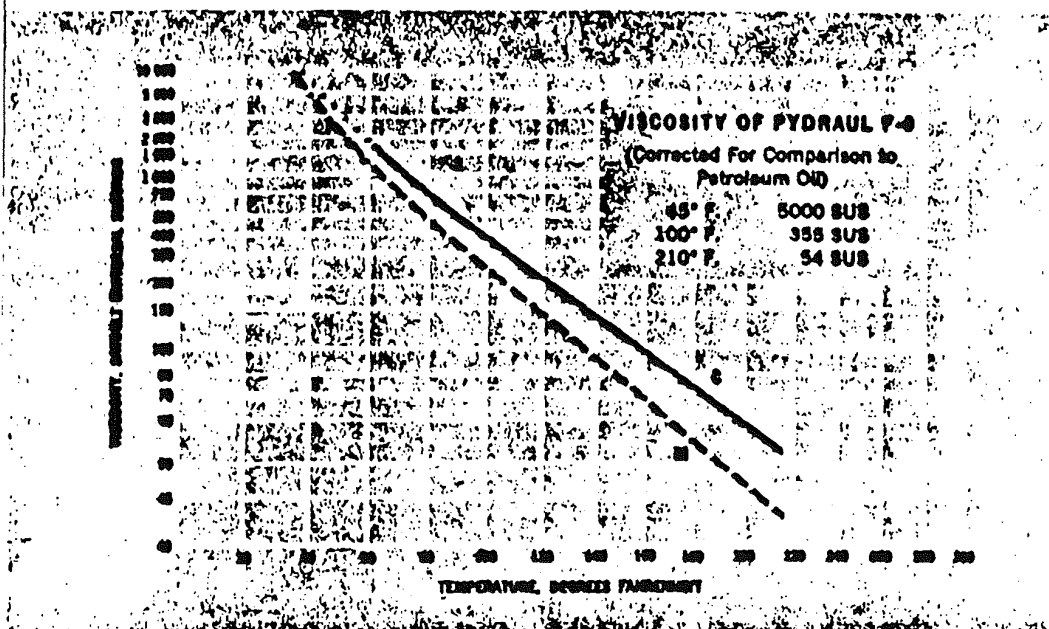
Pour
Almen

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Viscosity:

Laboratory viscosity measurements are affected by fluid density. Because all petroleum oils have similar densities, their measured viscosities can be compared. The densities of synthetic fluids vary, however, so the measured viscosities must be corrected in order to compare them.

In the graph below, curve "M" is the laboratory-measured viscosity of Pydraul F-9. "C" shows the viscosity-temperature relationship modified for the differences in density of oil and Pydraul F-9. By comparing curve "C" with a viscosity curve of a medium-weight petroleum hydraulic oil, you can see that the two are essentially equivalent at normal operating temperatures.



HANDLING AND STORAGE

Animal toxicity studies and human experience indicate that the Pydraul fluids may be used safely if a few reasonable precautions are taken. Repeated or prolonged skin contact should be avoided since the fluids are excellent solvents for the normal skin oils. When splashed or sprayed into the eyes, the Pydraul fluids cause painful smarting. There is no evidence, however, of any permanent eye injury. In the event of accidental contact with the eyes, the eyes should be flushed with plenty of water for 15 minutes and the workman referred to a physician. Physicians have used a 1% pontocaine solution and ophthalmic cortisone acetate solution to relieve irritation.

Respiratory protection or mechanical exhaust ventilation should be provided if there is repeated and prolonged contact of the fluid with heated surfaces with resulting volatilization or possible decomposition of the fluid. For short periods, such as might arise in turning off equipment following the rupture of hydraulic lines or other mechanical failure, no such protection is necessary. Toxicity studies demonstrate that the Pydraul fluids are generally comparable to petroleum-based hydraulic fluids with respect to short-term massive exposures. The details of animal toxicity studies are available from Monsanto's Medical Department.

Pydraul F-9 can be stored at sub-zero or high temperatures without freezing or heat damage to the fluid. Drums stored outside should be tightly sealed to prevent entry of moisture. Inside or sheltered storage is preferred.

NVF 003313

Monsanto

PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

SELECTOR

A guide to selecting the correct Pydraul fluid for
your hydraulic system.

O-FF/3



NVF 003325

PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

SELECTOR

A guide to selecting the correct Pydraul fluid for
your hydraulic system.

O-FF/3

FUNCTIONAL
FLUIDS



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NVF 003326

PYDRAUL[®] FLUIDS

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since served industry with millions of machine hours of fire-free operation. Pydraul fluid has never contributed to a fire — not even when sprayed from the broken ends of high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. The first Pydraul fluid, general-purpose Pydraul F-9, has grown to a family of six, specially tailored, fire-resistant hydraulic fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out — from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits —

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines that operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines that use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month — or even replaced from year to year.

NVF 003327

Converting to Pydraul is Easy

No matter what type of hydraulic fluid you now use in your equipment, you can easily convert to Pydraul. Virtually every type of hydraulic machinery requiring a fire-resistant hydraulic fluid has been converted to Pydraul. Equipment manufacturers are experienced in converting machinery to Pydraul and should be consulted for their specific recommendations. Some manufacturers will tell you exactly what seals to change. Most can supply the correct seals.

Machines operating on a *straight synthetic*, fire-resistant fluid can be converted to Pydraul without interrupting your production. When converting to Pydraul A-200, Pydraul 625, or Pydraul AC, simply add Pydraul as make-up. To convert to other Pydraul fluids, drain the old fluid and refill with the Pydraul fluid. No flush is necessary. For best seal performance, make your future seal selection according to recommendations in the booklet "Converting to Pydraul® Hydraulic Fluids."

Machines operating on oil or water-based hydraulic fluids require the few simple steps outlined below. These steps are necessary to clean the system of the old fluid and to change to dynamic seals compatible with Pydraul.

CHECK FOR LEAKS

Check your entire system for leaks before you shut down. Mark any leaks for sealing after the system is drained.

DRAIN THE SYSTEM

Drain your present fluid as completely as possible from reservoir, lines and cylinders. Flush system with steam or warm water to avoid residual oil and water-glycol sludge that can reduce Pydraul fluid fire-resistance. You may also be able to do this by opening unions at low spots in your system and blowing out with clean dry air. Seal any leaks.

CLEAN RESERVOIR AND FILTERS

If your reservoir is painted, use a commercial paint remover or scrape out the interior to prevent paint deterioration later on. Wipe your reservoir

clean with lint-free rags. Clean or change the cartridge in your filter.

CHECK PUMPS

Check your pumps thoroughly for wear. Replace any worn parts.

CHANGE SEALS, PACKINGS AND HOSES

Change your dynamic seals to seals compatible with Pydraul hydraulic fluid. If you use reinforced type hoses that are in good condition, you normally won't need to change them. If your hoses undergo severe flexing, we recommend butyl or Teflon-lined hoses. Your accumulator diaphragm should be of butyl, fluoroelastomers, EPDM or silicone. Avoid buna elastomers, neoprene and natural rubber.

RECONNECT LINES

Reconnect your lines, and tighten firmly. Fill your system with Pydraul to the manufacturer recommended level.

START AND STOP PUMP

With the hydraulic controls in neutral, start and stop your pump several times, without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system up to working pressure.

RUN THROUGH CYCLE

Run through the full operating cycle several times to use all parts of your system. Bleed any trapped air through the petcocks. Check your fluid level and add Pydraul if necessary.

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"Converting to Pydraul® Hydraulic Fluids," for complete information.

HOW TO EQUIP NEW MACHINERY WITH PYDRAUL

When ordering new hydraulic equipment, simply specify, "For use with Pydraul hydraulic fluid" and state the specific Pydraul you will use.

NVF 003328

Pydraul [®] Selector	PYDRAUL F-9	PYDRAUL 60
PHYSICAL PROPERTIES		
Appearance	Cloudy Blue Liquid	Cloudy Blue Liquid
Spec. Gravity 25°/25°C	1.280—1.295	1.088—1.091
Neutralization No. (acidity) (mg KOH/gm) max.	0.12—0.35	0.25
Moisture (max.)	0.20%	0.10%
VISCOSITY As measured: 100° F. 210° F. "Absolute Saybolts" 100° F. (SSU X Density) 210° F.	225 SSU 43.3 SSU 327 SSU 52 SSU	60 SSU 35 SSU 60.5 SSU 35 SSU
Pour Point	—5° F.	—70° F.
Compressibility X10 ⁻⁶ sq. in./lb.	2.58	3.05
Bulk Temperature Max.	300° F.	200° F.
Boiling Point °F at 760 mm Hg.	644° F.	707° F.
Coefficient of Thermal Expansion per °F.	0.00041	0.00044
Specific Heat (BTU/lb./° F.) (@ 77° F.)	0.32	0.42
Thermal Conductivity BTU/hr./ft./° F.	0.067	0.047
Vapor Pressure Hg @ 200° F.	0.1mm	0.01mm
Bulk Modulus (Room Temp. 1000-6000 psi)	387,000	328,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST		
High Pressure Spray Test AMS-3150B and MIL-F-7100. Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 6000° F.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing
Low Pressure Spray Test (AMS-3150B). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	No increase in flame intensity.	Slight increase in flame intensity.
Hot Manifold Test (MIL-F-7100). Test fluid dripped on tube at 1300° F.	Does not flash or burn.	Intermittent flashing and burning. Does not burn after leaving tube.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.	Does not ignite; flashes by spark.	Does not ignite.
Fire-resistance Advantages of Pydraul Pydraul fluids protect hydraulic equipment and personnel with permanent fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their more than one billion machine hours of use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks —without causing fire. Pydraul fluids have never caused or contributed to a hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance.		
	Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is now used in every major type of die-casting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer.	Low viscosity Pydraul 60 flows freely at —20° F., retains its properties and thermal stability at temperatures up to 200° F. In hydraulic operation that require precision flow instantly, Pydraul 60 supplies smooth operation from machine start to stop. It offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

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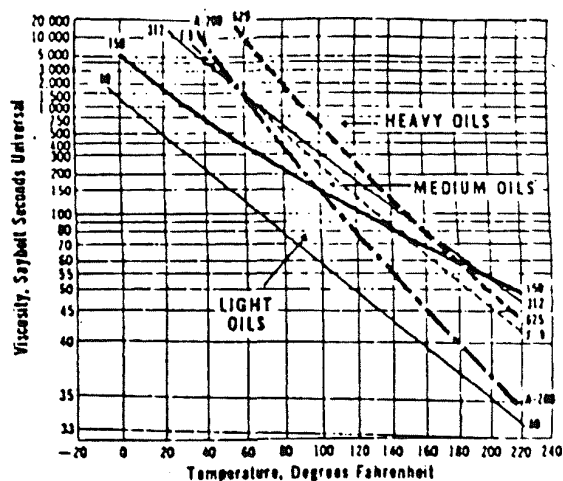
PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625
Cloudy Blue Liquid	Cloudy Blue Liquid	Blue Green Liquid	Cloudy Blue Liquid
1.119—1.135	1.415—1.430	1.100—1.115	1.340—1.360
0.17	0.80—1.10	0.30	0.30
0.15%	0.05%	0.10%	0.15%
145.9 SSU 52.5 SSU 163 SSU 56 SSU	144 SSU 35.7 SSU 204 SSU 48 SSU	312 SSU 50.9 SSU 346 SSU 56.5 SSU	625.7 SSU 45.9 SSU 845 SSU 59 SSU
-55° F.	+15° F.	-10° F.	+20° F.
3.13	2.28	2.74	2.66
200° F.	300° F.	225° F.	300° F.
617° F.	620° F.	615° F.	724° F.
0.00042	0.00040	0.00036	0.00040
0.40	0.28	0.36	0.28
0.072	0.068	0.069	0.065
0.1mm	0.2mm	0.1mm	0.09mm
319,000	438,000	365,000	375,000
Negligible	Negligible	Negligible	Negligible
Self-extinguishing.	Does not flash or ignite up to 34 feet from orifice.	Intermittent flashing but self-extinguishing.	Does not flash or ignite up to 3 feet from orifice.
Slight increase in flame intensity.	Slight increase in flame intensity.	Slight increase in flame intensity.	Very slight increase in flame intensity.
Intermittent flashing and burning. Little burning in pan below.	Does not flash or burn.	Intermittent flashing but does not propagate to pan below.	Does not flash or burn.
Does not ignite.	Does not ignite.	Does not ignite spontaneously. Flashes intermittently with ignition source.	Does not ignite.
Pydraul 150 is currently used in more than seven hundred G. P. E. (formerly Askania) regulators to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Pydraul A-200 is one of the most widely used, general-purpose, fire-resistant hydraulic fluids in industry. Introduced in 1959, it was the first fire-resistant, straight synthetic hydraulic fluid to break the "price/performance barrier." Pydraul A-200 performs like premium-grade petroleum oil in a wide variety of industrial applications, from die-casting to aluminum extrusion. It protects plants and personnel with chemically "inherent" fire-resistance, yet costs less than other straight synthetic fluids.	The newest fire-resistant hydraulic fluid. A break through in medium viscosity fluids that offers high performance and lubricity at the lowest cost in the industry. Pydraul 312 hydraulic fluid is a unique marriage of synthetic fluids with specially chosen petroleum fractions. The result is a fire-resistant hydraulic fluid that matches or excels the properties of existing synthetic and water-containing fluids . . . even the "anti-wear" petroleum oils. Today, Pydraul 312 can be used in all major types of die casting machines, hydraulic presses, automatic welding machines, and injection molding equipment with excellent results.	High viscosity Pydraul 625 is tailored for ultra-heavy duty hydraulic operations such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics that have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proven to be a top grade lubricant.

NVF 003330

Pydraul Viscosities

Laboratory viscosity measurements of SSU (Saybolt Seconds Universal) are affected by fluid density. Because all petroleum oils used for hydraulic operations have similar densities, their measured viscosities can be compared; however, the densities of synthetic fluids differ from one another and from petroleum oils. To compare viscosities, measured viscosities of synthetic fluids must be corrected for density.

Each curve on the chart shows the viscosity-temperature relationship modified for the difference in density of the indicated Pydraul fluid. By comparing these curves with viscosity curves of light, medium, and heavy grades of petroleum oils, it can be seen that Pydraul fluids virtually duplicate viscosities of petroleum oils at normal operating temperatures.



Absolute Saybolt Viscosity = Measured SSU $\times$ Density of Pydraul

Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as

premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent — they never evaporate or wear out.

	PYDRAUL F-9	PYDRAUL 80	PYDRAUL 160	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625
Timken Load (Passings)	50 lbs. 17,500 psi	14 lbs. 7,400 psi	40 lbs. 18,200 psi	50 lbs. 16,300 psi	55 lbs. 18,000 psi	55 lbs. 21,200 psi
Almen Wear	2.0 mgwt 4,200 psi	—	3.9 mgwt 4,000 psi	1.3 mgwt 4,000 psi	—	2.2 mgwt 4,000 psi
Almen Load	43 lbs. 25,000 psi	48 lbs. 25,000 psi	46 lbs. 23,000 psi	44 lbs. 24,000 psi	—	50 lbs. 23,000 psi
Falex Load—Low Load—lbs.	4100	2300	2000	4200	1800	4100
—Torque—lb. inches	93	73	64	90	35	89
Falex Wear (Under continuous load @ 100 lbs., loss in inches)						
1st 10 minutes	0.000428	0.000475	0.000428	0.000388	—	0.000618
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	—	0.000332
Steel Four-Ball Wear (147°F., 1 hr., 650 rpm, mm scar) Steel on Steel						
10 kg.	0.78	0.27	0.36	0.29	0.25	0.26
40 kg.	0.67	0.48	0.51	0.43	0.44	0.42
Steel on Bronze						
10 kg.	1.18	0.82	0.80	1.40	0.87	1.10
40 kg.	1.28	2.35	1.58	1.70	—	1.19
Pump Test—Viskors (V-100-E, 140°F., 1000 hrs.)						
Ring, grams (loss or gain)	-0.0084	-0.0037	-0.1212	-0.0848	-0.0013	-0.0013
Valve, grams (loss or gain)	-0.0011	-0.1059	-0.0378	-0.0191	-0.0021	-0.0015
Bushing 2015 grams (loss or gain)	+0.0120	+0.0008	-0.1601	-0.0151	+0.0081	-0.0045
Bushing 2016 grams (loss or gain)	-0.0063	-0.0020	-0.1134	-0.0217	-0.0057	-0.0050

NVF 003331

Mixing Compatibility

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	200	312	625
CELLULUBE						
90	NO	YES	NO	YES	NO	YES
150	NO	YES	NO	YES	NO	YES
220	NO	YES	NO	YES	NO	YES
300	NO	YES	NO	YES	NO	YES
550	NO	YES	NO	YES	NO	YES
HOUGHTO-SAFE						
1010	NO	YES	NO	YES	NO	YES
1055	NO	YES	NO	YES	NO	YES
1120	NO	YES	NO	YES	NO	YES
1130	NO	YES	NO	YES	NO	YES

PYDRAUL WITH OTHER PYDRAULS

F9	—	NO	YES	YES	YES	YES
60	NO	—	NO	YES	NO	YES
150	YES	NO	—	YES	YES	YES
200	YES	YES	YES	—	YES	YES
312	YES	NO	YES	YES	—	YES
625	YES	YES	YES	YES	YES	—

WATER-GLYCOL and WATER-OIL EMULSION Fluids —
Pydraul hydraulic fluids are not compatible with these fluids.

Handling and Storage

As with all specialized industrial fluids, certain precautions are advisable when handling Pydraul fluids. No problems will arise when Pydraul fluids are used as recommended.

Avoid repeated or continuous skin contact. Repeated or prolonged contact can lead to drying of the skin "chapping." Where prolonged skin contact cannot be avoided, gloves should be worn.

At room temperatures, there is no vapor inhalation hazard from Pydraul; however, inhalation of vapors at high temperatures should be prevented. In extensive animal experimentation, exposures to vapors for one hour showed local respiratory irritation, although no systemic effects were produced.

Although eye irritation studies using Pydraul at full strength indicate Pydraul is a mild irritant, there is no evidence to show Pydraul causes permanent damage to eye tissues. If Pydraul fluid is splashed or sprayed into the eyes, eyes should be thoroughly flushed with water and the workman referred to a physician. To relieve irritation, physicians have used 1% pontocaine solution, as well as the ophthalmic cortisone acetate solution.

Pydraul hydraulic fluids can be stored at subzero temperatures without fluid damage. Before using, simply allow the fluid to warm to room temperature. Drums stored outside should be sealed tightly and placed in a horizontal position to keep out moisture.

NVF 003332

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AKRON, OHIO 44311

920 Brown Street
P. O. Box 2307
Tel. (216) Hemlock 4-1821

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PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

SELECTOR

A guide to selecting the correct Pydraul fluid for
your hydraulic system.

O-FF/3



NVF 003325

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NVF 003326

PYDRAUL[®] FLUIDS

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since served industry with millions of machine hours of fire-free operation. Pydraul fluid has never contributed to a fire — not even when sprayed from the broken ends of high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. The first Pydraul fluid, general-purpose Pydraul F-9, has grown to a family of six, specially tailored, fire-resistant hydraulic fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out — from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits —

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines that operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines that use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month — or even replaced from year to year.

NVF 003327

Converting to Pydraul is Easy

No matter what type of hydraulic fluid you now use in your equipment, you can easily convert to Pydraul. Virtually every type of hydraulic machinery requiring a fire-resistant hydraulic fluid has been converted to Pydraul. Equipment manufacturers are experienced in converting machinery to Pydraul and should be consulted for their specific recommendations. Some manufacturers will tell you exactly what seals to change. Most can supply the correct seals.

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Drain your present fluid as completely as possible from reservoir, lines and cylinders. Flush system with steam or warm water to avoid residual oil and water-glycol sludge that can reduce Pydraul fluid fire-resistance. You may also be able to do this by opening unions at low spots in your system and blowing out with clean dry air. Seal any leaks.

CLEAN RESERVOIR AND FILTERS

If your reservoir is painted, use a commercial paint remover or scrape out the interior to prevent paint deterioration later on. Wipe your reservoir

clean with lint-free rags. Clean or change the cartridge in your filter.

CHECK PUMPS

Check your pumps thoroughly for wear. Replace any worn parts.

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RECONNECT LINES

Reconnect your lines, and tighten firmly. Fill your system with Pydraul to the manufacturer's recommended level.

START AND STOP PUMP

With the hydraulic controls in neutral, start and stop your pump several times, without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system up to working pressure.

RUN THROUGH CYCLE

Run through the full operating cycle several times to use all parts of your system. Bleed any trapped air through the petcocks. Check your fluid level and add Pydraul if necessary.

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Pour Point	—5° F.	—70° F.
Compressibility X10 ⁻⁴ sq. in./lb.	2.58	3.05
Bulk Temperature Max.	300° F.	200° F.
Boiling Point °F at 760 mm Hg.	644° F.	707° F.
Coefficient of Thermal Expansion per °F.	0.00041	0.00044
Specific Heat (BTU/lb./° F.) (@ 77° F.)	0.32	0.42
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Bulk Modulus (Room Temp. 1000-6000 psi)	387,000	328,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST		
High Pressure Spray Test AMS-3150B and MIL-F-7100. Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 6000° F.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing
Low Pressure Spray Test (AMS-3150B). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	No increase in flame intensity.	Slight increase in flame intensity.
Hot Manifold Test (MIL-F-7100). Test fluid dripped on tube at 1300° F.	Does not flash or burn.	Intermittent flashing and burning Does not burn after leaving tube.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.	Does not ignite: flashes by spark.	Does not ignite.
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	Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is now used in every major type of die-casting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer.	Low viscosity Pydraul 60 flows freely at —20° F. It retains its properties and thermal stability at temperatures up to 200° F. In hydraulic operations that require precision flow instantly, Pydraul 60 supplies smooth operation from machine start to stop. It offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

NVF 003329

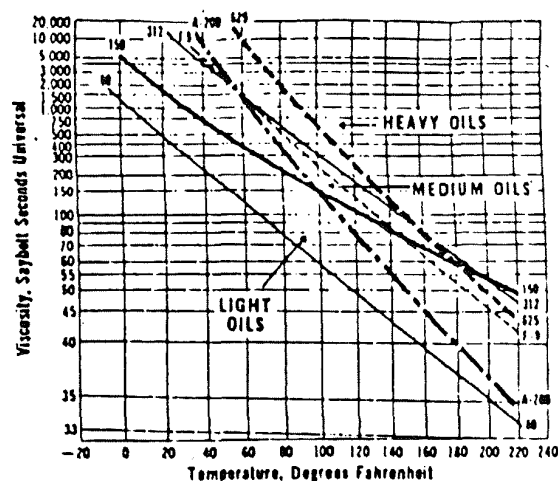
PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625
Cloudy Blue Liquid	Cloudy Blue Liquid	Blue Green Liquid	Cloudy Blue Liquid
1.119—1.135	1.415—1.430	1.100—1.115	1.340—1.360
0.17	0.80—1.10	0.30	0.30
0.15%	0.05%	0.10%	0.15%
145.9 SSU 52.5 SSU 163 SSU 56 SSU	144 SSU 35.7 SSU 204 SSU 48 SSU	312 SSU 50.9 SSU 346 SSU 56.5 SSU	625.7 SSU 45.9 SSU 845 SSU 59 SSU
-55° F.	+15° F.	-10° F.	+20° F.
3.13	2.28	2.74	2.66
200° F.	300° F.	225° F.	300° F.
617° F.	620° F.	615° F.	724° F.
0.00042	0.00040	0.00036	0.00040
0.40	0.28	0.36	0.28
0.072	0.068	0.069	0.065
0.1mm	0.2mm	0.1mm	0.09mm
319,000	438,000	365,000	375,000
Negligible	Negligible	Negligible	Negligible
Self-extinguishing.	Does not flash or ignite up to 3½ feet from orifice.	Intermittent flashing but self-extinguishing.	Does not flash or ignite up to 3 feet from orifice.
Slight increase in flame intensity.	Slight increase in flame intensity.	Slight increase in flame intensity.	Very slight increase in flame intensity.
Intermittent flashing and burning. Little burning in pan below.	Does not flash or burn.	Intermittent flashing but does not propagate to pan below.	Does not flash or burn.
Does not ignite.	Does not ignite.	Does not ignite spontaneously. Flashes intermittently with ignition source.	Does not ignite.
Pydraul 150 is currently used in more than seven hundred G. P. E. (formerly Askania) regulators to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Pydraul A-200 is one of the most widely used, general-purpose, fire-resistant hydraulic fluids in industry. Introduced in 1959, it was the first fire-resistant, straight synthetic hydraulic fluid to break the "price/performance barrier." Pydraul A-200 performs like premium-grade petroleum oil in a wide variety of industrial applications, from die-casting to aluminum extrusion. It protects plants and personnel with chemically "inherent" fire-resistance, yet costs less than other straight synthetic fluids.	The newest fire-resistant hydraulic fluid. A break through in medium viscosity fluids that offers high performance and lubricity at the lowest cost in the industry. Pydraul 312 hydraulic fluid is a unique marriage of synthetic fluids with specially chosen petroleum fractions. The result is a fire-resistant hydraulic fluid that matches or excels the properties of existing synthetic and water-containing fluids . . . even the "anti-wear" petroleum oils. Today, Pydraul 312 can be used in all major types of die casting machines, hydraulic presses, automatic welding machines, and injection molding equipment with excellent results.	High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics that have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proven to be a top-grade lubricant.

NVF 003330

Pydraul Viscosities

Laboratory viscosity measurements of SSU (Saybolt Seconds Universal) are affected by fluid density. Because all petroleum oils used for hydraulic operations have similar densities, their measured viscosities can be compared; however, the densities of synthetic fluids differ from one another and from petroleum oils. To compare viscosities, measured viscosities of synthetic fluids must be corrected for density.

Each curve on the chart shows the viscosity-temperature relationship modified for the difference in density of the indicated Pydraul fluid. By comparing these curves with viscosity curves of light, medium, and heavy grades of petroleum oils, it can be seen that Pydraul fluids virtually duplicate viscosities of petroleum oils at normal operating temperatures.



Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as

premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent — they never evaporate or wear out.

	PYDRAUL F-8	PYDRAUL 88	PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625
Timken Load (Passing)	50 lbs. 17,500 psi	14 lbs. 7,400 psi	40 lbs. 18,200 psi	50 lbs. 16,300 psi	55 lbs. 18,000 psi	55 lbs. 21,200 psi
Almen Wear	2.0 mggr 4,000 psi	—	3.9 mggr 4,000 psi	1.3 mggr 4,000 psi	—	2.2 mggr 4,000 psi
Almen Load	43 lbs. 25,000 psi	48 lbs. 25,000 psi	46 lbs. 23,000 psi	44 lbs. 24,000 psi	—	50 lbs. 23,000 psi
Falex Load—Jaw Load—lbs.	4100	2300	2000	4200	1800	4100
—Torque—lb. inches	93	73	64	90	35	89
Falex Wear (Under continuous load @ 100 lbs., loss in inches)						
1st 10 minutes	0.000428	0.000475	0.000428	0.000388	—	0.000618
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	—	0.000332
Shell Four-Ball Wear (167°F, 1 hr., 620 rpm, mm scar) Steel on Steel						
10 kg.	0.28	0.27	0.36	0.29	0.25	0.26
40 kg.	0.67	0.48	0.51	0.43	0.44	0.62
Steel on Bronze						
10 kg.	1.18	0.62	0.80	1.40	0.87	1.10
40 kg.	1.28	2.25	1.58	1.70	—	1.19
Pump Test—Vickers (V-106-E, 160°F, 1000 hrs.)						
Ring, grams (loss or gain)	-0.0084	-0.0037	-0.1212	-0.0848	-0.0013	-0.0013
Vaner, grams (loss or gain)	-0.0011	-0.1859	-0.0378	-0.0191	-0.0021	-0.0015
Bushing 2015 grams (loss or gain)	+0.0170	+0.0008	-0.1601	-0.0151	+0.0081	-0.0045
Bushing 2016 grams (loss or gain)	-0.0063	-0.0020	-0.1134	-0.0217	-0.0057	-0.0050

NVF 003331

Mixing Compatibility

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	200	312	625
CELLULUBE						
90	NO	YES	NO	YES	NO	YES
150	NO	YES	NO	YES	NO	YES
220	NO	YES	NO	YES	NO	YES
300	NO	YES	NO	YES	NO	YES
550	NO	YES	NO	YES	NO	YES
HOUGHTON-SAFE						
1010	NO	YES	NO	YES	NO	YES
1055	NO	YES	NO	YES	NO	YES
1120	NO	YES	NO	YES	NO	YES
1130	NO	YES	NO	YES	NO	YES

PYDRAUL WITH OTHER PYDRAULS

F9	—	NO	YES	YES	YES	YES
60	NO	—	NO	YES	NO	YES
150	YES	NO	—	YES	YES	YES
200	YES	YES	YES	—	YES	YES
312	YES	NO	YES	YES	—	YES
625	YES	YES	YES	YES	YES	—

WATER-GLYCOL and WATER-OIL EMULSION Fluids —
Pydraul hydraulic fluids are not compatible with these fluids.

Handling and Storage

As with all specialized industrial fluids, certain precautions are advisable when handling Pydraul fluids. No problems will arise when Pydraul fluids are used as recommended.

Avoid repeated or continuous skin contact. Repeated or prolonged contact can lead to drying and skin "chapping." Where prolonged skin contact cannot be avoided, gloves should be worn.

At room temperatures, there is no vapor inhalation hazard from Pydraul; however, inhalation of vapors at high temperatures should be prevented. In extensive animal experimentation, exposures to vapors for one hour showed local respiratory irritation, although no systemic effects were produced.

Although eye irritation studies using Pydraul at full strength indicate Pydraul is a mild irritant there is no evidence to show Pydraul cause permanent damage to eye tissues. If Pydraul fluid is splashed or sprayed into the eyes, eyes should be thoroughly flushed with water and the workman referred to a physician. To relieve irritation, physicians have used 1% pontocain solution, as well as the ophthalmic cortisone acetate solution.

Pydraul hydraulic fluids can be stored at subzero temperatures without fluid damage. Before using, simply allow the fluid to warm to room temperature. Drums stored outside should be sealed tightly and placed in a horizontal position to keep out moisture.

NVF 003332

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NVF 003334

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PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

SELECTOR I

A guide to selecting the correct Pydraul fluid for
your hydraulic system.

O-FF/3



NVF 003372

PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

SELECTOR I

A guide to selecting the correct Pydraul fluid for
your hydraulic system.

O-FF/3

FUNCTIONAL
FLUIDS



"Nothing functional herein is to be construed as a recommendation to use any product in contact with any system. MONSANTO MAKES NO WARRANTIES AS TO THE FITNESS OR MERCHANTABILITY OF ANY PRODUCTS REFERRED TO, no guarantee of satisfactory results from systems upon continued information or recommendations, and disclaims all liability for any resulting loss or damage."

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NVF 003373

PYDRAUL[®] FLUIDS

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since served industry with millions of machine hours of fire-free operation. Pydraul fluid has never contributed to a fire — not even when sprayed from the broken ends of high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. The first Pydraul fluid, general-purpose Pydraul F-9, has grown to a family of 12, specially tailored, fire-resistant hydraulic fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out — from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits —

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines which operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines which use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month — or replaced from year to year.

NVF 003374

Converting to Pydraul is Easy

No matter what type of hydraulic fluid you now use in your equipment, you can easily convert to Pydraul. Virtually every type of hydraulic machinery requiring a fire-resistant hydraulic fluid has been converted to Pydraul. Equipment manufacturers are experienced in converting machinery to Pydraul and should be consulted for their specific recommendations. Some manufacturers will tell you exactly what seals to change. Most can supply the correct seals.

Machines operating on a *straight synthetic*, fire-resistant fluid can be converted to Pydraul without interrupting your production. When converting to Pydraul A-200, Pydraul 625, or Pydraul AC, simply add Pydraul as make-up. To convert to other Pydraul fluids, drain the old fluid and refill with the Pydraul fluid. No flush is necessary. For best seal performance, make your future seal selection according to recommendations in the booklet "Converting to Pydraul® Hydraulic Fluids."

Machines operating on oil or water-based hydraulic fluids require the few simple steps outlined below. These steps are necessary to clean the system of the old fluid and to change to dynamic seals compatible with Pydraul.

CHECK FOR LEAKS

Check your entire system for leaks before you shut down. Mark any leaks for sealing after the system is drained.

DRAIN THE SYSTEM

Drain your present fluid as completely as possible from reservoir, lines and cylinders. Flush system with steam or warm water to avoid residual oil and water-glycol sludge which can reduce Pydraul fluid fire-resistance. You may also be able to do this by opening unions at low spots in your system and blowing out with clean dry air. Seal any leaks.

CLEAN RESERVOIR AND FILTERS

If your reservoir is painted, use a commercial paint remover or scrape out the interior to prevent paint deterioration later on. Wipe your reservoir

clean with lint-free rags. Clean or change the cartridge in your filter.

CHECK PUMPS

Check your pumps thoroughly for wear. Replace any worn parts.

CHANGE SEALS, PACKINGS AND HOSES

Change your dynamic seals to seals compatible with Pydraul hydraulic fluid. If you use reinforced type hoses which are in good condition, you normally won't need to change them. If your hoses undergo severe flexing, we recommend butyl or Teflon-lined hoses. Your accumulator diaphragms should be of butyl, fluoroelastomers, EPDM or silicone. Avoid buna elastomers, neoprene and natural rubber in dynamic seal locations.

RECONNECT LINES

Reconnect your lines, and tighten firmly. Fill your system with Pydraul to the manufacturer's recommended level.

START AND STOP PUMP

With the hydraulic controls in neutral, start and stop your pump several times, without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system up to working pressure.

RUN THROUGH CYCLE

Run through the full operating cycle several times to use all parts of your system. Bleed any trapped air through the petcocks. Check your fluid level and add Pydraul if necessary.

ASK FOR THE BOOKLET

"Converting to Pydraul® Hydraulic Fluids," for complete information.

HOW TO EQUIP NEW MACHINERY WITH PYDRAUL

When ordering new hydraulic equipment, simply specify, "For use with Pydraul hydraulic fluid" and state the specific Pydraul you will use.

NVF 003375

Pydraul® Selector 1

	PYDRAUL F-9	PYDR.
PHYSICAL PROPERTIES		
Appearance	Cloudy Blue Liquid	Cloudy 31
Spec. Gravity 25°, 25°C	1.280—1.295	1.068
Neutralization No. (acidity) (mg KOH, gm) max.	0.10—0.35	0.2
Moisture (max.)	0.20%	0.10%
VISCOSITY		
Centistokes @ 100° F.	43 to 53	9.6 to 10.3
210° F.	5.0 to 5.8	2.3 to 2.5
Saybolts as @ 100° F.	225 SSU	60 SSU
measured: 210° F.	43.3 SSU	35 SSU
"Absolute Saybolts" @ 100° F.	327 SSU	60 SSU
(SSU X Density) 210° F.	52 SSU	35 SSU
Pour Point	—5° F.	—10° F.
Compressibility X10 ⁻⁴ sq. in./lb.	2.58	3.25
Bulk Temperature Max. (for continuous operation)	225° F.	175° F.
Boiling Point °F at 760 mm Hg.	644° F.	707° F.
Coefficient of Thermal Expansion per °F.	0.00041	0.00041
Specific Heat (BTU lb./° F.) (@ 77° F.)	0.32	0.42
Thermal Conductivity BTU hr. ft./° F.	0.067	0.047
Vapor Pressure Hg @ 200° F.	0.1mm	0.01mm
Bulk Modulus (Room Temp. 1000-6000 psi)	387,000	328,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST		
High Pressure Spray Test AMS-3160C and Federal Test Method Std. 791. Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 6000° F.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing.
Low Pressure Spray Test (AMS-3160C). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	No increase in flame intensity.	Slight increase in flame.
Hot Manifold Test (Federal Test Method Std. 791). Test fluid dripped on tube at 1300° F.	Does not flash or burn.	Intermittent flashing. Does not burn after 10 sec.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.	Does not ignite; flashes by spark.	Does not ignite.
Fire-resistance Advantages of Pydraul Pydraul fluids protect hydraulic equipment and personnel with permanent fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their more than one billion machine hours of use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks—without causing fire. Pydraul fluids have never caused or contributed to a hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance. Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is now used in every major type of die-casting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer. Low viscosity Pydraul flows freely at —20° F. It has properties and thermal stability at temperatures up to 225° F. In hydraulic operation, Pydraul 60 requires precise control instantly. Pydraul 60 smooth operation in machine start to stop, flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, efficient, hydraulic operation in vane, gear and piston in high-speed machines.		

NVF 003376

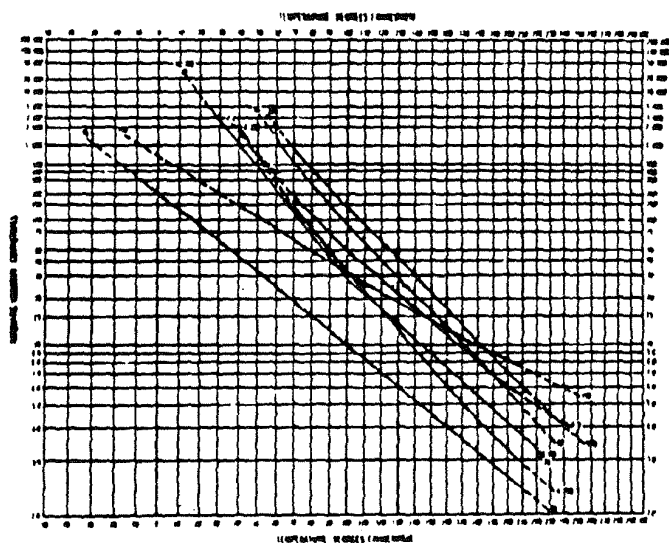
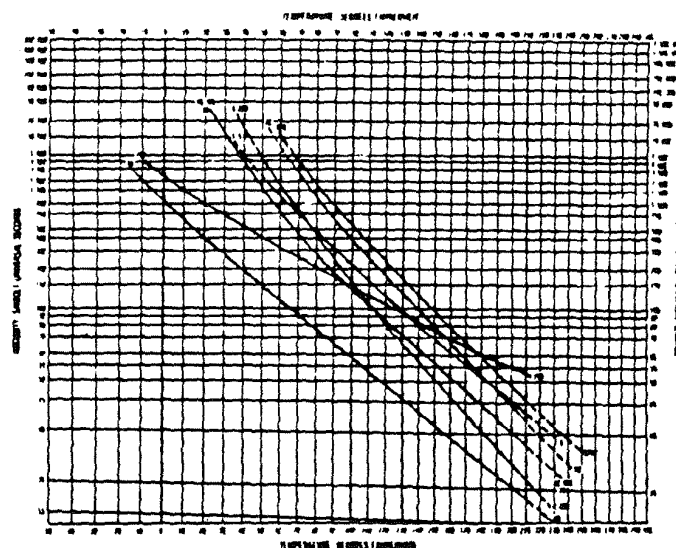
PYDRAUL 150	PYDRAUL A-200	PYDRAUL 625	PYDRAUL AC	PYDRAUL AC WINTER GRADE 28
Cloudy Blue Liquid	Cloudy Blue Liquid	Cloudy Blue Liquid	Clear Blue Liquid	Clear Blue Liquid
1 120-1 131	1 415-1 430	1 360-1 400	1 345-1 385	1 275-1 295
0 17	0 80-1 10	0 30	0 15	0 15
0.10%	0 05%	0 15%	0 15%	0 15%
29 to 34 6 9 to 8 1 145 9 SSU 52 9 SSU 163 SSU 56 SSU	30 0 to 33 0 2 8 to 3 0 144 SSU 35 7 SSU 204 SSU 48 SSU	125 to 145 5 7 to 6 2 625 7 SSU 45 9 SSU 845 SSU 59 SSU	82 to 92 4 6 to 5 0 408 8 SSU 42 1 SSU 550 SSU 50 SSU	26 to 30 3 5 to 3 9 408 8 SSU 42 1 SSU 180 SSU 52 SSU
-55° F.	+15° F.	+30° F.	+20° F.	0° F.
3 13	2 28	2 66	2 66	2 66
150° F.	250° F.	225° F. (max. exit air temp. 350° F.)	225° F. (max. exit air temp. 350° F.)	225° F. (max. exit air temp. 350° F.)
617° F.	620° F.	724° F.	688° F.	688° F.
0 00042	0 00040	0 00040	0 00040	0 00040
0 40	0 28	0 28	0 32	0 32
0 072	0 068	0 065	0 066	0 066
0 1mm	0 2mm	0 09mm	2 0 × 10 ⁻³	2 0 × 10 ⁻³
319,000	438,000	375,000	375,000	375,000
Negligible	Negligible	Negligible	Negligible	Negligible
Self-extinguishing.	Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3½ feet from orifice.
Slight increase in flame intensity.	Slight increase in flame intensity.	Very slight increase in flame intensity.	Very slight increase in flame intensity.	Very slight increase in flame intensity.
Intermittent flashing and burning. Little burning in pan below.	Does not flash or burn.	Does not flash or burn.	Does not flash or burn.	Does not flash or burn.
Does not ignite.	Does not ignite.	Does not ignite.	Does not ignite.	Does not ignite.
Pydraul 150 is used in hydraulic systems to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Pydraul A-200 is one of the most widely used, general-purpose, fire-resistant hydraulic fluids in industry. Introduced in 1959, it was the first fire-resistant, straight synthetic hydraulic fluid to break the "price/performance barrier." Pydraul A-200 performs like premium-grade petroleum oil in a wide variety of industrial applications, from die-casting to aluminum extrusion. It protects plants and personnel with chemically "inherent" fire-resistance, yet costs less than other straight synthetic fluids.	High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics that have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proven to be a top-grade lubricant.	Pydraul AC is a special safety lubricant for air compressors which provides several important advantages over petroleum oil for this use. Pydraul AC reduces the threat of compressor fires and explosions by eliminating combustible mists and minimizing carbonaceous residues. Costs of compressor downtime and cleaning are greatly reduced, because Pydraul AC virtually eliminates deposits on exhaust valves, in coolers, and in piping. These lower maintenance costs alone usually justify Pydraul AC for air compressors.	Pydraul AC Winter Grade is a low temperature formula of Pydraul AC lubricant, recommended for air compressors which operate in ambient temperatures.

NVF 003377

Pydraul Viscosities

Laboratory viscosity measurements of SSU (Saybolt Seconds Universal) are affected by fluid density. Because all petroleum oils used for hydraulic operations have similar densities, their measured viscosities can be compared; however, the densities of synthetic fluids differ from one another and from petroleum oils. To compare viscosities, measured viscosities of synthetic fluids must be corrected for density.

Each curve on the two charts (SSU and Centistokes) shows the viscosity-temperature relationship modified for the difference in density of the indicated Pydraul fluid. By comparing these curves with viscosity curves of light, medium, and heavy grades of petroleum oils, it can be seen that Pydraul fluids virtually duplicate viscosities of petroleum oils at normal operating temperatures.



NVF 003378

Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as

premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent — they never evaporate or wear out.

	PYDRAUL F-9	PYDRAUL 60	PYDRAUL 150	PYDRAUL A-200	PYDRAUL 312	PYDRAUL 625	PYDRAUL AC*
Timken Load (Passing)	50 lbs. 17,500 psi	14 lbs. 7,400 psi	40 lbs. 18,200 psi	50 lbs. 16,300 psi	55 lbs. 18,000 psi	55 lbs. 21,200 psi	50 lbs. 23,250 psi
Almen Wear	2.0 mg ϕ 4,000 psi	—	3.9 mg ϕ 4,000 psi	1.3 mg ϕ 4,000 psi	—	2.2 mg ϕ 4,000 psi	—
Almen Load	43 lbs. 25,000 psi	48 lbs. 25,000 psi	46 lbs. 23,000 psi	44 lbs. 24,000 psi	—	50 lbs. 23,000 psi	—
Falex Load—Low Load—Lbs.	4100	2300	2000	4200	1800	4100	3600
—Torque—lb. inches	93	73	64	90	35	79	58
Falex Wear (Under continuous load @ 100 lbs., less in inches)							
1st 10 minutes	0.000428	0.000475	0.000428	0.000380	—	0.000418	0.000428
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	—	0.000332	0.000285
Shelf Four-Ball Wear (187°F., 1 hr., 180 rpm, mm wear) Steel on Steel							
10 kg.	0.28	0.27	0.36	0.29	0.25	0.26	0.32
40 kg.	0.67	0.48	0.51	0.43	0.44	0.62	0.78
Steel on Bronze							
10 kg.	1.18	0.82	0.80	1.40	0.87	1.10	—
40 kg.	1.78	2.35	1.58	1.70	—	1.19	—
Pump Test—Vickers (V-105-B, 140°F., 1000 hrs.)							
Ring, grams (loss or gain)	-0.0084	-0.0037	-0.1212	-0.0848	-0.0013	-0.0013	-0.0076
Vanee, grams (loss or gain)	-0.0011	-0.1850	-0.0378	-0.0191	-0.0021	-0.0015	-0.0014
Bushing 2015 grams (loss or gain)	+0.0120	+0.0008	-0.1601	-0.0151	+0.0081	-0.0045	+0.0040
Bushing 2016 grams (loss or gain)	-0.0063	-0.0829	-0.1134	-0.0217	-0.0057	-0.0050	-0.0045

*Values for Pydraul AC Winter Grade 28 are essentially equivalent to those for Pydraul AC.

Mixing Compatibility

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	200	312*	625	AC	AC-WG28
CELLULUBE								
90	NO	YES	NO	YES	NO	YES	YES	YES
150	NO	YES	NO	YES	NO	YES	YES	YES
220	NO	YES	NO	YES	NO	YES	YES	YES
300	NO	YES	NO	YES	NO	YES	YES	YES
550	NO	YES	NO	YES	NO	YES	YES	YES
HOUGHTON-SAFE								
1010	NO	YES	NO	YES	NO	YES	YES	YES
1055	NO	YES	NO	YES	NO	YES	YES	YES
1120	NO	YES	NO	YES	NO	YES	YES	YES
1130	NO	YES	NO	YES	NO	YES	YES	YES

PYDRAUL WITH OTHER PYDRAUL FLUIDS

	F9	60	150	200	312*	625	AC	AC-WG28
F9	—	NO	YES	YES	YES	YES	YES	YES
60	NO	—	NO	YES	NO	YES	YES	YES
150	YES	NO	—	YES	YES	YES	YES	YES
200	YES	YES	YES	—	YES	YES	YES	YES
312	YES	NO	YES	YES	—	YES	YES	NO
625	YES	YES	YES	YES	YES	—	YES	YES
AC	YES	YES	YES	YES	YES	YES	—	YES
AC-WG28	YES	YES	YES	YES	NO	YES	YES	—

WATER-GLYCOL and WATER-OIL EMULSION Fluids — Pydraul hydraulic fluids are not compatible with these fluids.

*Pydraul 312 is one of a family of new Pydraul fire-resistant fluids characterized by high performance and low cost. The other fluids in this family have the same compatibility as Pydraul 312 with other hydraulic fluids and with other Pydraul fluids. The new Pydraul fluids include: Pydraul 90, Pydraul 175, Pydraul 220, Pydraul 312, and Pydraul 500.

NVF 003379

Handling and Storage

As with all specialized industrial fluids, certain precautions are advisable when handling Pydraul fluids. No health problems should arise when Pydraul fluids are used as recommended.

Avoid repeated or continuous skin contact. Repeated or prolonged contact can lead to drying and skin "chapping." Where prolonged skin contact cannot be avoided, gloves should be worn.

At room temperatures, there is no vapor inhalation hazard from Pydraul; however, inhalation of vapors at high temperatures should be prevented. In animal experimentation, exposures to vapors for one hour showed local respiratory irritation, although no systemic effects were produced.

Although eye irritation studies using Pydraul at full strength indicate Pydraul is a mild irritant, there is no evidence to show Pydraul causes permanent damage to eye tissues. If Pydraul fluid is splashed or sprayed into the eyes, eyes should be thoroughly flushed with water and the workman referred to a physician. To relieve irritation, physicians have used 1% pontocaine solution, as well as the ophthalmic cortisone acetate solution.

Pydraul hydraulic fluids can be stored at sub-zero temperatures without fluid damage. Before using, simply allow the fluid to warm to room temperature. Drums stored outside should be sealed tightly and placed in a horizontal position to keep out moisture.

NVF 003380

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SELECTOR

PYDRAUL[®]

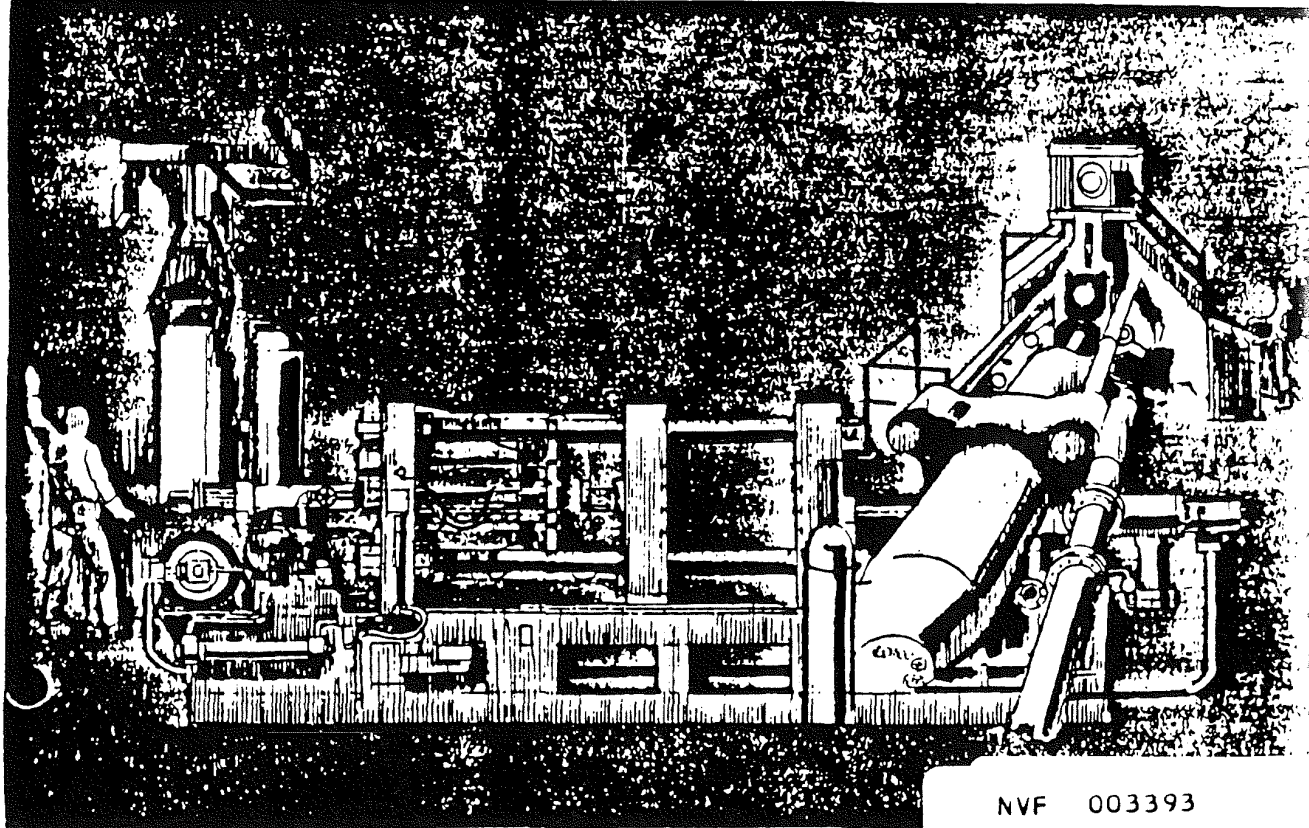
Fire-Resistant Hydraulic Fluid

1

A guide to selecting the correct Pydraul fluid for hydraulic systems.

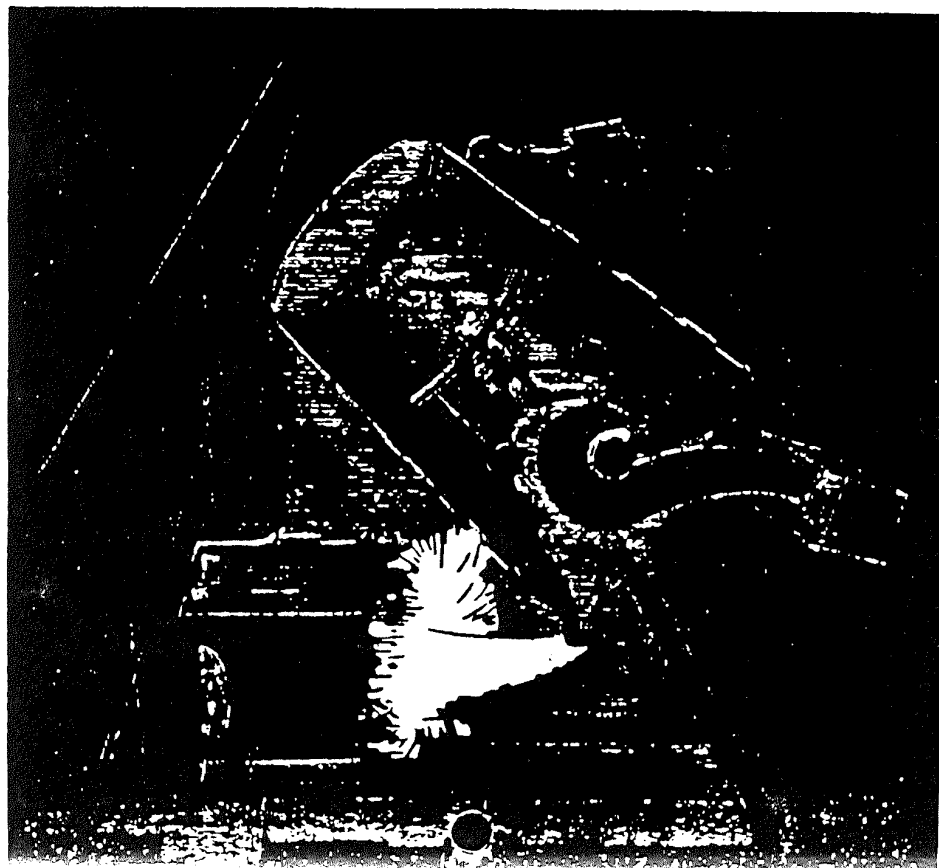
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Monsanto



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PYDRAUL fluids

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since provided industry with millions of machine hours of safe operation. Pydraul fluid has never caused a fire—not even when sprayed from broken high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. From the first Pydraul fluid,

(Pydraul F-9) the family has grown to a dozen-plus specially tailored, fire-resistant safety fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out—from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits—

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines which operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines which use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month—or replaced from year to year.

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PYDRAUL® Selector One

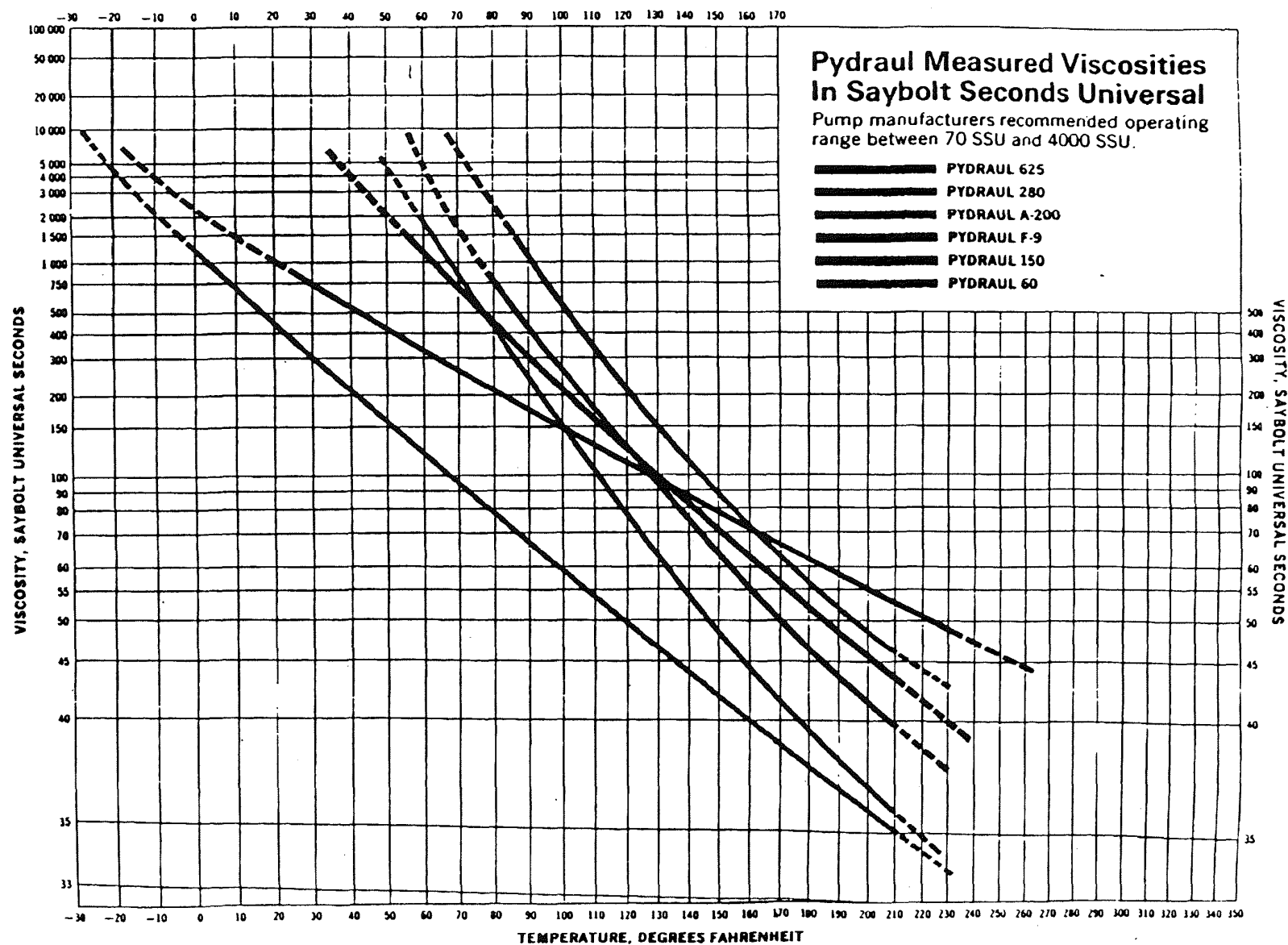
	PYDRAUL F-9	PYDRAUL A-200
PHYSICAL PROPERTIES		
Appearance	Cloudy Blue Liquid	Cloudy Blue Liquid
Spec. Gravity 25°/25°C.	1.280—1.295	1.415—1.430
Neutralization No. (acidity) (mg KOH/gm) max.	0.10—0.35	0.80—1.10
Moisture (max.)	0.20%	0.05%
VISCOSITY		
Centistokes @ 100°F.	43 to 53 cs	30.0 to 33.0 cs
210°F.	5.0 to 5.8 cs	2.8 to 3.0 cs
Saybolt's @ 100°F.	225 SSU	144 SSU
measured: 210°F.	43.3 SSU	35.7 SSU
"Absolute Saybolt's" @ 100°F.	327 SSU	704 SSU
(SSU x Density) 210°F.	52 SSU	48 SSU
Pour Point	-5°F.	+15°F.
Compressibility x 10 ⁴ sq. in./lb.	2.58	2.28
Bulk Temperature Max. (for continuous operation)	225°F.	250°F.
Boiling Point °F at 760 mm Hg.	664°F.	620°F.
Coefficient of Thermal Expansion per °F.	0.00041	0.00040
Specific Heat BTU/lb./°F. @ 77°F.	0.32	0.28
Thermal Conductivity BTU/hr./ft./°F.	0.067	0.068
Vapor Pressure Hg @ 200°F.	0.1mm	0.2mm
Bulk Modulus (Room Temp. 1000-5000 psi)	387,000	438,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST		
High Pressure Spray Test (AMS-3150C and Federal Test Method Std. 791) Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 5000°F.	Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up feet from orifice.
Low Pressure Spray Test (AMS-3150C). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	No increase in flame intensity.	Slight increase in flame intensity.
Hot Manifold Test (Federal Test Method Std. 791). Test fluid dripped on at 1300°F.	Does not flash or burn.	Does not flash or burn.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200°F., to test for spontaneous ignition.	Does not ignite; flashes by spark.	Does not ignite.
Fire-resistance Advantages of Pydraul Pydraul fluids protect hydraulic equipment and personnel with permanent fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their millions of hours of machine use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks—without causing fire. Pydraul fluids have never caused or contributed to a hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance.		
	Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is used in every major type of diecasting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer. Pydraul F-9 is listed by Underwriters Laboratories for use in hazardous hydraulic applications. It is also approved by Factory Mutual and U.S. Bureau of mines.	Pydraul A-200 is one of the widely used, general-purpose fire resistant hydraulic fluids in industry. Introduced in 1954, it was the first fire resistant straight synthetic hydraulic fluid to break the "performance barrier." Pydraul A-200 performs as well as premium-grade petroleum oils in a wide variety of industrial applications, from die-cast aluminum extrusion, to plants and personnel with "inherent" fire hazard, yet costs less than straight synthetic fluids. Pydraul A-200 is approved by Factory Mutual.

PYDRAUL 280	PYDRAUL 625	PYDRAUL 150	PYDRAUL 60
Cloudy Blue Liquid	Cloudy Blue Liquid	Cloudy Blue Liquid	Cloudy Blue Liquid
1.385-1.405	1.360-1.400	1.120-1.131	1.088-1.091
0.7-0.5	0.30	0.17	0.25
0.15%	0.15%	0.10%	0.10%
56 to 62 cs 3.9 to 4.1 cs 274 SSU 39.1 SSU 382 SSU 54.5 SSU +70°F. 2.47 225°F. 671°F. 0.00040 0.28 0.066 0.15mm 400,000 Negligible	125 to 145 cs 5.7 to 6.2 cs 625.7 SSU 45.9 SSU 845 SSU 59 SSU +30°F. 2.66 225°F. 724°F. 0.00040 0.28 0.065 0.09mm 375,000 Negligible	29 to 34 cs 6.9 to 8.1 cs 145.9 SSU 52.9 SSU 163 SSU 56 SSU -55°F. 3.13 150°F. 617°F. 0.00042 0.40 0.072 0.1mm 319,000 Negligible	9.6 to 10.4 cs 2.3 to 2.5 cs 60 SSU 35 SSU 60.5 SSU 35 SSU -70°F. 3.05 175°F. 707°F. 0.00044 0.42 0.047 0.01mm 328,000 Negligible
Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing.	Self-extinguishing.
Very slight increase in flame intensity.	Very slight increase in flame intensity.	Slight increase in flame intensity.	Slight increase in flame intensity.
Does not flash or burn.	Does not flash or burn.	Intermittent flashing and burning. Little burning in pan below.	Intermittent flashing and burning. Does not burn after leaving tube.
Does not ignite.	Does not ignite.	Does not ignite.	Does not ignite.
Pydraul 280 is a shear stable, higher viscosity medium range safety fluid. Developed specifically for hydraulic clutches in German coal mines, Pydraul 280 has proved successful in a variety of hydraulic applications including diecasting machines and automatic welders. Blended to provide a fluid with a viscosity range between Pydraul A-200 and Pydraul 625, Pydraul 280 shows performance proved with qualities equal to those of the long accepted Pydraul fluids. Pydraul 280 is approved by Factory Mutual.	High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics which have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proved to be a top-grade lubricant. Pydraul 625 is approved by Factory Mutual.	Pydraul 150 is used in hydraulic systems to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Low viscosity Pydraul 60 flows freely at -20°F. It retains its properties and thermal stability at temperatures up to 200°F. In hydraulic operations that require precision flow instantly, Pydraul 60 supplies smooth operation from machine start to stop; it offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

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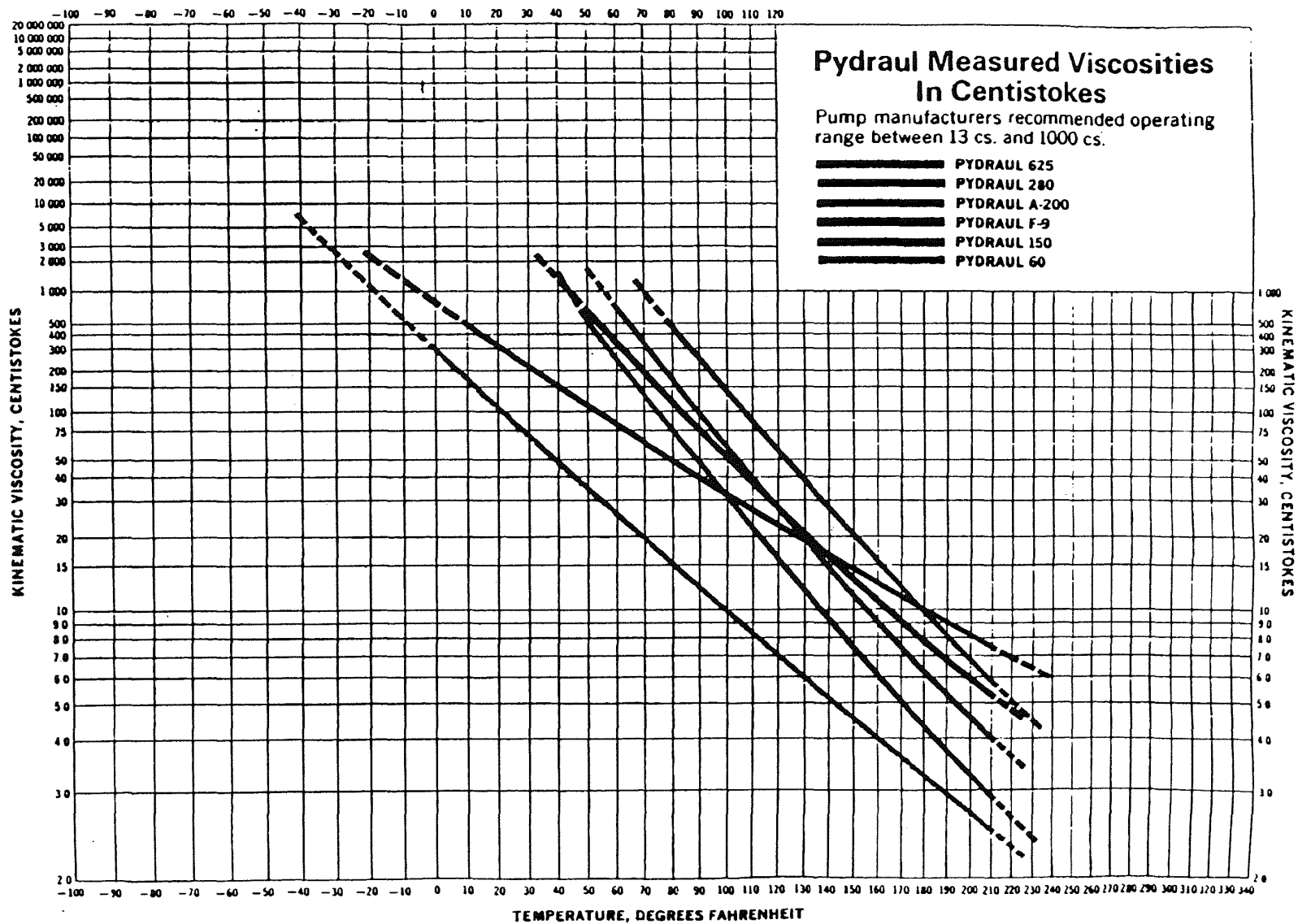
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Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium

petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent—they never evaporate or wear out.

	PYDRAUL F-9	PYDRAUL 60	PYDRAUL 150	PYDRAUL A-200	PYDRAUL 280	PYDRAUL 625
Linken Load (Passing)	50 lbs.	14 lbs.	40 lbs.	50 lbs.	53 lbs.	55 lbs.
	17,500 psi	7,400 psi	18,200 psi	16,300 psi	19,400 psi	21,200 psi
Almen Wear	2.0 mg/ft	—	1.9 mg/ft	1.3 mg/ft	1.7 mg/ft	2.2 mg/ft
	4,000 psi		4,000 psi	4,000 psi	4,000 psi	1,000 psi
Almen Load	43 lbs.	48 lbs.	46 lbs.	44 lbs.	47 lbs.	50 lbs.
	25,000 psi	25,000 psi	23,000 psi	24,000 psi	23,500 psi	23,200 psi
Talex Load—Jaw Load—Lbs.	4100	2300	2000	4200	4100	4100
— Torque—lb. inches	93	73	64	90	87	89
Talex Wear (Under continuous load or 100 lbs., loss in inches)						
1st 10 minutes	0.000428	0.000475	0.000428	0.000380	0.000490	0.000618
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	0.000356	0.000332
Shell Four-Ball Wear (167°F. 1 hr., 630 rpm, mm scar)						
Steel on Steel						
10 kg.	0.28	0.27	0.36	0.29	0.25	0.26
40 kg.	0.67	0.48	0.51	0.43	0.52	0.62
Steel on Bronze						
10 kg.	1.18	0.82	0.80	1.40	1.25	1.10
40 kg.	1.28	2.35	1.58	1.70	1.44	1.19
Pump Test—Vickers (V-105-E, 140°F. 1000 hrs.)						
Ring, grams (loss or gain)	-0.0084	-0.0037	-0.1212	-0.0848		-0.0013
Vanes, grams (loss or gain)	-0.0011	-0.1859	-0.0378	-0.0191		-0.0015
Bushing 2015 grams (loss or gain)	+0.0120	+0.0008	-0.1601	-0.0151		-0.0045
Bushing 2016 grams (loss or gain)	-0.0063	-0.0020	-0.1134	-0.0217		-0.0050

Mixing Compatibility

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	A-200	312*	280	625
FYRQUEL (formerly Cellulube)							
90	NO	YES	NO	YES	NO	YES	YES
150	NO	YES	NO	YES	NO	YES	YES
220	NO	YES	NO	YES	NO	YES	YES
300	NO	YES	NO	YES	NO	YES	YES
550	NO	YES	NO	YES	NO	YES	YES
HOUGHTO-SAFE							
1010	NO	YES	NO	YES	NO	YES	YES
1055	NO	YES	NO	YES	NO	YES	YES
1120	NO	YES	NO	YES	NO	YES	YES
1130	NO	YES	NO	YES	NO	YES	YES

PYDRAUL WITH OTHER PYDRAUL FLUIDS

	F9	60	150	A-200	312*	280	625
F9	—	NO	YES	YES	YES	YES	YES
60	NO	—	NO	YES	NO	YES	YES
150	YES	NO	—	YES	YES	YES	YES
A-200	YES	YES	YES	—	YES	YES	YES
312	YES	NO	YES	YES	—	YES	YES
280	YES	YES	YES	YES	YES	—	YES
625	YES	YES	YES	YES	YES	YES	—

WATER-GLYCOL and WATER-OIL EMULSION Fluids—Pydraul hydraulic fluids are not compatible with these fluids.

*Pydraul 312 is one of a family of new low-cost synthetic base Pydraul hydraulic fluids characterized by high performance and low cost. The other fluids in this family have the same compatibility as Pydraul 312 with other hydraulic fluids and with other Pydraul fluids. The new Pydraul fluids include: Pydraul 30, Pydraul 135, Pydraul 230, Pydraul 317, Pydraul 540.

Converting to PYDRAUL is Easy

Regardless of the type hydraulic fluid being used, converting a system to low-cost Pydraul fluids is easy. Virtually every type of equipment which uses fire-resistant hydraulic fluid has been converted to Pydraul fluids. Most equipment manufacturers are experienced in Pydraul fluid conversions and should be consulted.

If changing seals is necessary, equipment manufacturers can recommend what seals to change, and many carry a supply of correct seals. Laboratory tests and operational experience show Viton*, Teflon*, and silicone the preferred elastomers for compatible seals. For moderate temperatures (below 140°F) butyl seals, hose, etc. are usually acceptable. Nylon and Teflon are satisfactory for higher temperatures.

To replace other fluids which are compatible with Pydraul and where compatible seals are in the system, it is only necessary to add Pydraul as make-up fluid. It is not necessary to drain or clean. When converting from petroleum oils, non-compatible synthetic fluids, water-glycol fluids, or water-in-oil emulsions, the following steps are recommended. These conform to USA Standard B93.5--1966. For best seal performance, make your future seal selection according to recommendations on page 8 in this booklet.

Please ask the Monsanto fluids specialist for recommendations and assistance, or telephone our technical specialists in St. Louis directly (314) 694-2500.

Change-Over Procedures

CHANGING FROM PETROLEUM OIL

1. Completely drain and clean the system. Small amounts of oil will not interfere with the performance of Pydraul, but resistance to fire is reduced by the amount of oil left in the system.
2. Drain and blow out pipelines. Manually clean valves and reservoirs.

*Registered trademark of E. I. Du Pont de Nemours & Co., Inc.

3. Open or remove and drain valves. Replace gaskets, packings, and seals with those compatible with Pydraul. It is particularly important to change dynamic seals. Static seals do not necessarily have to be changed if they are not leaking. Non-compatible static seals will have to be replaced when the part is disassembled for maintenance.
4. Remove pumps, accumulators, and cylinders, if necessary, for draining. Replace packings, seals, gaskets, and bladders with those compatible with Pydraul.
5. Check component functions before the system is closed and fluid is added.
6. If your system cannot be completely drained, you may have to flush it with a small amount of Pydraul.

CHANGING FROM WATER-GLYCOL OR WATER-IN-OIL EMULSION

1. Drain and clean system thoroughly. Remove all traces of water. Empty all lines and low points or dead pockets in components.
2. Clean with steam or warm water. Follow by blowing with dry air.
3. Check sealing materials, hoses, and accumulator bags. Replace if necessary with compatible materials.
4. Install a minimum charge of Pydraul and operate the system from 16 to 24 hours. During this period, inspect the reservoir. If water or other contaminants float to the top, skim them off.
5. Drain the flushing charge immediately after shut-down while the fluid is warm. Drain all isolated points or parts which do not drain back to the reservoir. If water is apparent in fluid clinging to walls, wipe down all accessible parts.

CHANGING FROM PHOSPHATE ESTERS (OTHER THAN PYDRAUL)

1. Drain the system completely.
2. Cleaning is unnecessary.
3. Generally, seal changes are unnecessary at the time of conversion, but installation of compatible seals is recommended during routine maintenance.

Seals and Packings Information

Materials compatible with Pydraul hydraulic fluid are necessary for dynamic or moving seals. For static seals they are preferred, but not essential. The following table indicates materials recommended, depending on the Pydraul fluid selected.

PYDRAUL FLUID	BUTYL	EPR	VITON	SILICONE	BUNA N	NEOPRENE	NATURAL RUBBER
A-200	M	M	R	R	U	U	U
F-9	S	S	R	R	U	U	U
150	R	R	S	R	U	U	U
625	S	S	R	R	U	U	U
280	S	S	R	R	U	U	U
60	R	R	U	S	U	U	U

R—Recommended

S—Satisfactory

M—Marginal

U—Unsatisfactory

This list of component manufacturers is a guide to obtaining seals compatible with Pydraul fluids. Please contact your equipment manufacturer or seal supplier for their most current recommendations.

Acushnet Process Company
776 Belleville Avenue
New Bedford, Massachusetts 02745

Anchor Packing Company
401 North Broad Street
Philadelphia, Pennsylvania 19108

Bearings, Inc.
3634 Euclid Avenue
Cleveland, Ohio 44115

A. W. Chesterton Company
Everett
Massachusetts 02149

Chicago Rawhide Manufacturing Company
1311 Elston Avenue
Chicago, Illinois 60622

C. E. Conover & Company, Inc.
333 Passaic Avenue
Fairfield, New Jersey 07006

Crane Packing Company
6400 Dakton Street
Morton Grove, Illinois 60053

Garlock Packing Company
Palmyra
New York 14522

Goshen Rubber Company, Inc.
P. O. Box 416
Goshen, Indiana 46526

Greene, Tweed & Company
North Wales
Pennsylvania 19454

Hercules Packing Corporation
11061 Walden Road
Alden, New York 14004

International Packing Corporation
Bristol
New Hampshire 03104

Johns-Manville
22 East 40th Street
New York, New York 10016

C. W. Marsh Company
36 Hudson Street
Muskegon, Michigan 49441

Minnesota Rubber Company
3630 Wooddale Avenue
Minneapolis, Minnesota 55416

Parker Seal Company
10567 Jefferson Boulevard
Culver City, California 90230

Plastic & Rubber Engineering, Inc.
756 East Florence Avenue
Los Angeles, California 90001

Plastic & Rubber Products Company
2100 Hyde Park Boulevard
Los Angeles, California 90047

Precision Rubber Products Corporation
Hartmann Drive
Lebanon, Tennessee 37087

Raybestos-Manhattan, Inc.
Packing Division
Passaic, New Jersey

Reliable Rubber Products
Eddington
Pennsylvania 19020

Rockwell Mechanical Packing Company, Inc.
1634 Long Beach Avenue
Los Angeles, California 90021

W. S. Shamban Company
11617 West Jefferson Boulevard
Culver City, California 90230

Vellumoid Company
Rockdale Street and Beaman Avenue
Worcester, Massachusetts 01606

The James Walker Packing Company, Inc.
P. O. Box 75
Chicago Heights, Illinois 60411

Filters and Hoses

FILTERS/Most standard oil filters are satisfactory. You can use active earth or clay types. Filter manufacturers include:

Briggs Filtration Division
Bowser Corporation
Cookeville, Tennessee

Capital Engineering Company
5839 Ashland Avenue
Chicago, Illinois

Commercial Filters Corporation
(Honan-Crane)
Lebanon, Indiana

Cuno Engineering Corporation
Sub. of American Machine
& Foundry
4627 S. Vine Street
Meriden, Connecticut

Dollinger Corporation
20 Centre Park
Rochester 3, New York

Fulflo Specialties Company, Inc.
410 Fancy Avenue
Blanchester, Ohio

Hilliard Corporation
98 W. Fourth Street
Elmira, New York

Marvel Engineering Company
7227 North Hamlin Avenue
Chicago 45, Illinois

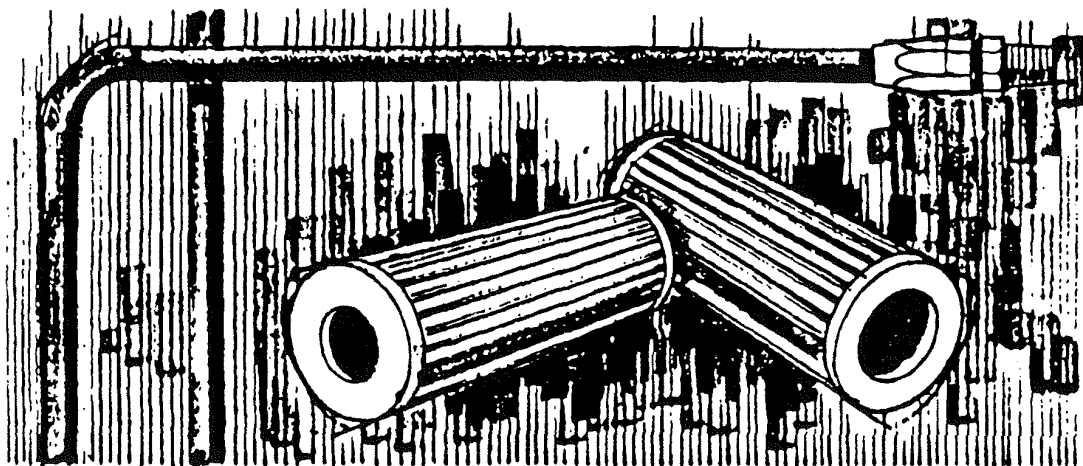
Pall Corporation
32 Sea Cliff Avenue
Glen Cove, L. I., New York

Purolator Products
1000 New Brunswick Avenue
Rahway, New Jersey

Rosaen Filter Corporation
1776 E. Nine Mile Road
Hazel Park, Michigan

Schroeder Bros. Corporation
101 Nichol Avenue
McKees Rocks, Pennsylvania

Serfilco Division
Service Filtration Corporation
7408 North Milwaukee
Niles, Illinois 60648



HOSES/Although both neoprene and buna elastomers swell somewhat in hydraulic hose of these materials have given satisfactory service when made of a reinforced braid construction. Butyl, nylon or Viton are preferred when new hoses are installed. Suppliers include:

Anchor Coupling Company
3600 N. Fourth Street
Libertyville, Illinois

Eastman Mfg. Company
(See Imperial-Eastman Corp.)
Department T. R.
6300 West Howard Street
Chicago 48, Illinois

Electric Hose & Rubber Co.
1201 Duro Street
Wilmington, Delaware

Gates Rubber Company
999 South Broadway
Denver, Colorado 80217

Imperial Eastman Corp.
6300 W. Howard Street
Chicago, Illinois

Lewis Products
Hohenwald, Tennessee 38462

Samuel Moore Co.
Mantua, Ohio

Resistoflex Corp.
Roseland, New Jersey

Stratoflex, Inc.
222 Roberts Cutoff Rd.
Fort Worth, Texas

Weatherhead Corp.
302 E. 131st Street
Cleveland, Ohio 44108

Other Components

SWIVEL COUPLINGS

Systems for Pydraul fluids often contain swivel couplings. Some suppliers are:

Chiksan Division
FMC Corporation
332 N. Brea Boulevard
Brea, California

PIPE JOINT SEALERS

... can be bought from:

American Sealants Company
(See Loctite Corporation)
115 N. Mountain Road
Hartford 11, Connecticut

Crane Packing Company
6410 Oakton Street
Morton Grove, Illinois

Dow Corning Corporation
Midland, Michigan

Friesland Plastics Company
Friesland, Wisconsin

General Electric Company
Insulating Materials Department
1 Campbell Road
Schenectady 6, New York

Permatex Company
Department T. R.
Flagler Court Building
West Palm Beach, Florida

W. S. Shamban & Company
11617 W. Jefferson Boulevard
Culver City, California

Shell Chemical Company
110 W. 51st Street
New York, New York

ACCUMULATORS

... many hydraulic systems for Pydraul contain an accumulator which uses a bladder to separate the fluid from air or nitrogen pressure. For these, a rubber compatible with the fluid is necessary. Suppliers include:

Greer Hydraulics, Inc.
5930 W. Jefferson Boulevard
Los Angeles, California

PAINTS

... resistant to Pydraul are supplied by:

Amercoat Corporation
Department T
Brea, California

Andrew Brown Paint Company
5413 S. District Boulevard
Los Angeles, California

Carboline Company
32-R Hanley Industrial Court
St. Louis, Missouri

Carrol Products
148 Marine Street
Farmingdale, New York

Finch Paint & Chemical Company
Torrence, California

W. P. Fuller & Company
1645 W. Valencia Drive
Fullerton, California

The Glidden Company
900 Union Commerce Building
Cleveland, Ohio

Interchemical Corporation
Finishes Division
1255-T Broad Street
Clifton, New Jersey

Lowe Brothers Company
Third & Madison Streets
Dayton, Ohio

Magna Coatings & Chemical Corporation
1785 N. Eastern Avenue
Los Angeles, California

Nycote Laboratories
15002 Delano Street
Van Nuys, California

Pittsburgh Plate Glass Company
One Gateway Center
Pittsburgh 22, Pennsylvania

Rinshed-Mason Company
5935 Milford
Detroit, Michigan

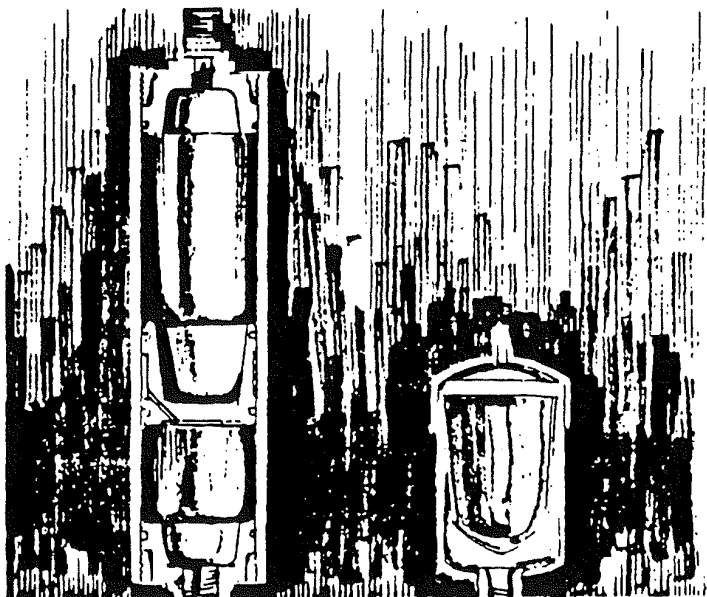
Royalty Paint & Varnish Company
Pasadena, California

Saran Protective Coatings Company
2415 Burdette at Reed
Ferndale, Michigan

Sherwin-Williams Company
101 Prospect Avenue, N. W.
Cleveland, Ohio

Titanine, Inc.
Seagrave Corporation
Elmwood & Morris Avenues
Union, New Jersey

U. S. Paint, Lacquer & Chemical Company
2101 Singleton
St. Louis, Missouri



NVF 003404

Reclaiming PYDRAUL Fluids

Pydraul hydraulic fluid lost from leaks and spills can be reclaimed because it is exceptionally stable and resistant to water and other contaminants. If fluid losses are appreciable—fluid recovery can result in considerable savings. Simply placing a container beneath leaks until they can be repaired will save some fluid. Where drip pans have been used beneath hydraulic

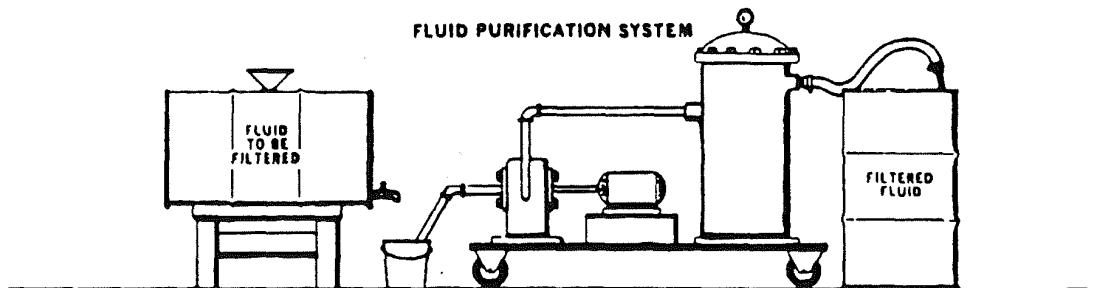
machinery, more than half of the total Pydraul leakage has been reclaimed.

This dollar-saving recovery appears especially advantageous because it isn't practical to reclaim either water glycol or water-oil emulsions except to filter out large dirt particles. Reclaiming Pydraul fluid helps make it the most economical fire-resistant fluid available.

Reclaiming Pydraul consists of two steps; removing water, and filtering dirt or other solid particles.

WATER REMOVAL... Water does not mix with Pydraul and will, therefore, form a layer on top. A drum reserved for contaminated fluid with a side and end bung, placed horizontally on a cradle about two feet off the floor, is a simple

and effective settling chamber. Salvaged fluid can be added through a large funnel in the top opening and Pydraul periodically drained off through the lower opening.

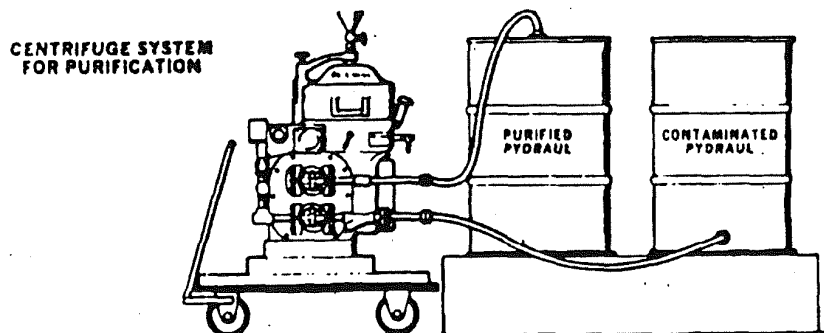


For a more elaborate system, permanently installed settling tanks, or a commercial installation can be used.

A second method is centrifuging. Suitable units are made by Delaval and Sharples Co. Centrifuges operate swiftly . . . will separate water from large volumes of fluid in a short time.

FINAL FILTRATION . . . A number of filtration units are available complete with filter pump

and motor. Other systems use filter media such as cotton linters, felt or metal screens. Attapulga clay and Fuller's earth may be used to help keep the fluid clean, reduce moisture and lower neutralization number. Diatomaceous earth filtration is recommended for solid particles removal only. Paper and fiber type filters are recommended for water and particle removal but are ineffective for lowering neutralization number (acidity) values.



Filters in the 3 to 5 micron range are recommended for Pydraul filtration and reclamation. Such filter media will not affect the basic Pydraul formulation.

Handling

Animal toxicity studies and human experience indicate that the Pydraul hydraulic fluids may be used safely if a few reasonable precautions are taken. Repeated or prolonged skin contact should be avoided not only to prevent absorption of the material and possible systemic effect but, also, because the fluids are excellent solvents for the oils normally present in the skin. Thus, drying and irritation could occur.

When splashed or sprayed into the eyes, Pydraul causes painful smarting. There is no evidence, however, of any permanent eye injury. In the event of accidental contact with the eyes, the eyes should be flushed with copious amounts of water for 15 minutes and the workman referred to a physician; physicians have used 1% Pontocaine solution and ophthalmic cortisone acetate solution to relieve irritation.

When Pydraul is kept at room temperature, it does not constitute a vapor inhalation hazard except in a confined, unventilated space. Respiratory protection or mechanical exhaust ventilation should be provided if there is repeated and prolonged contact of the fluid with heated surfaces with resulting volatilization or possible decomposition of the fluid. Where a ruptured oil hydraulic line near a white-hot surface means a fire, a ruptured hydraulic line containing Pydraul causes a vapor with an unpleasant odor that can help you locate the trouble. For short periods, such as turning off equipment following the rupture of a hydraulic line or other mechanical failure, no protection is necessary.



NVF 003406

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SELECTOR

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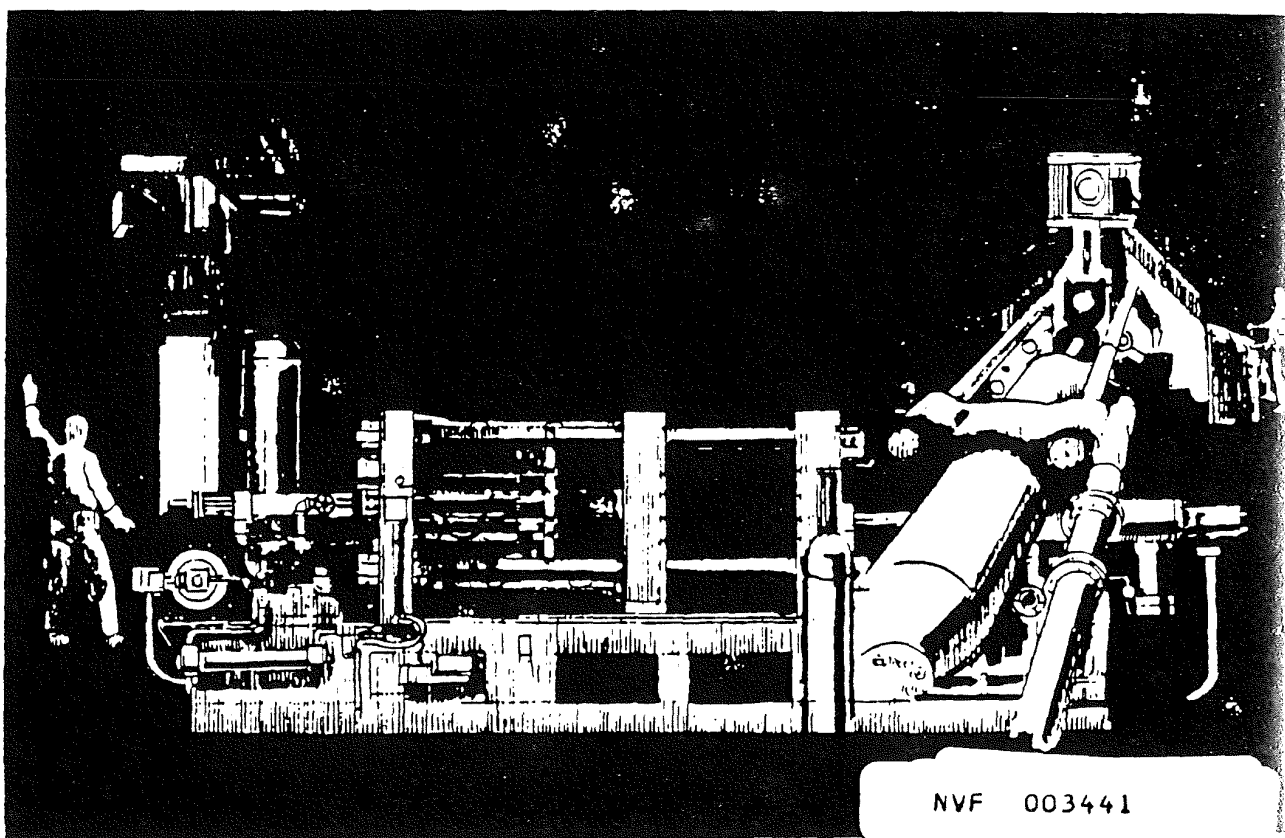
PYDRAUL[®]

Fire-Resistant Hydraulic Fluid

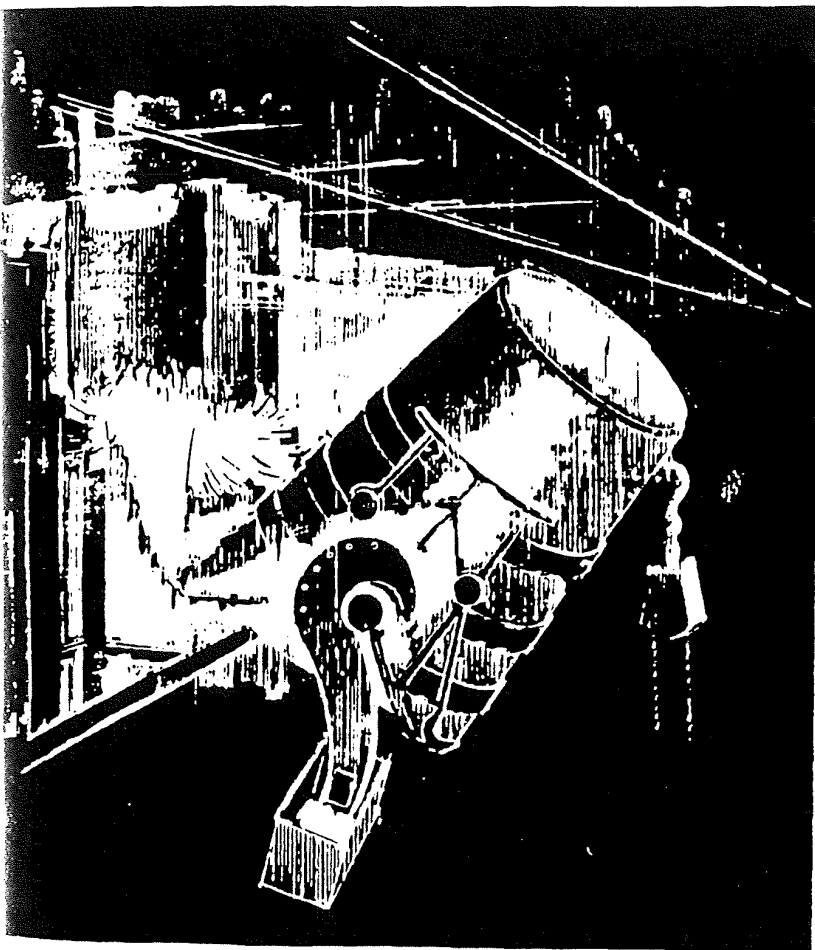
A guide to selecting the correct Pydraul fluid for hydraulic systems.

O.F.F.

Monsanto



NVF 003442



PYDRAUL fluids

Development

Fire protection for industrial hydraulic operations began with Pydraul in 1951. Pydraul fluids have since provided industry with millions of machine hours of safe operation. Pydraul fluid has never caused a fire—not even when sprayed from broken high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. From the first Pydraul fluid,

(Pydraul F-9) the family has grown to a dozen-plus specially tailored, fire-resistant safety fluids. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out—from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

Performance

Pydraul fluids offer a wide range of viscosities from which you can select the proper range specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits—

REDUCED FIRE INSURANCE RATES

Pydraul eliminates fire hazards from hydraulic operations, reduces fire threats to surrounding structure and equipment. Insurance premiums for plants using Pydraul are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines which operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines which use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. Pydraul hydraulic fluids do not lose anti-rust properties even after extended use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month—or replaced from year to year.

NVF 003443

PYDRAUL® Selector One

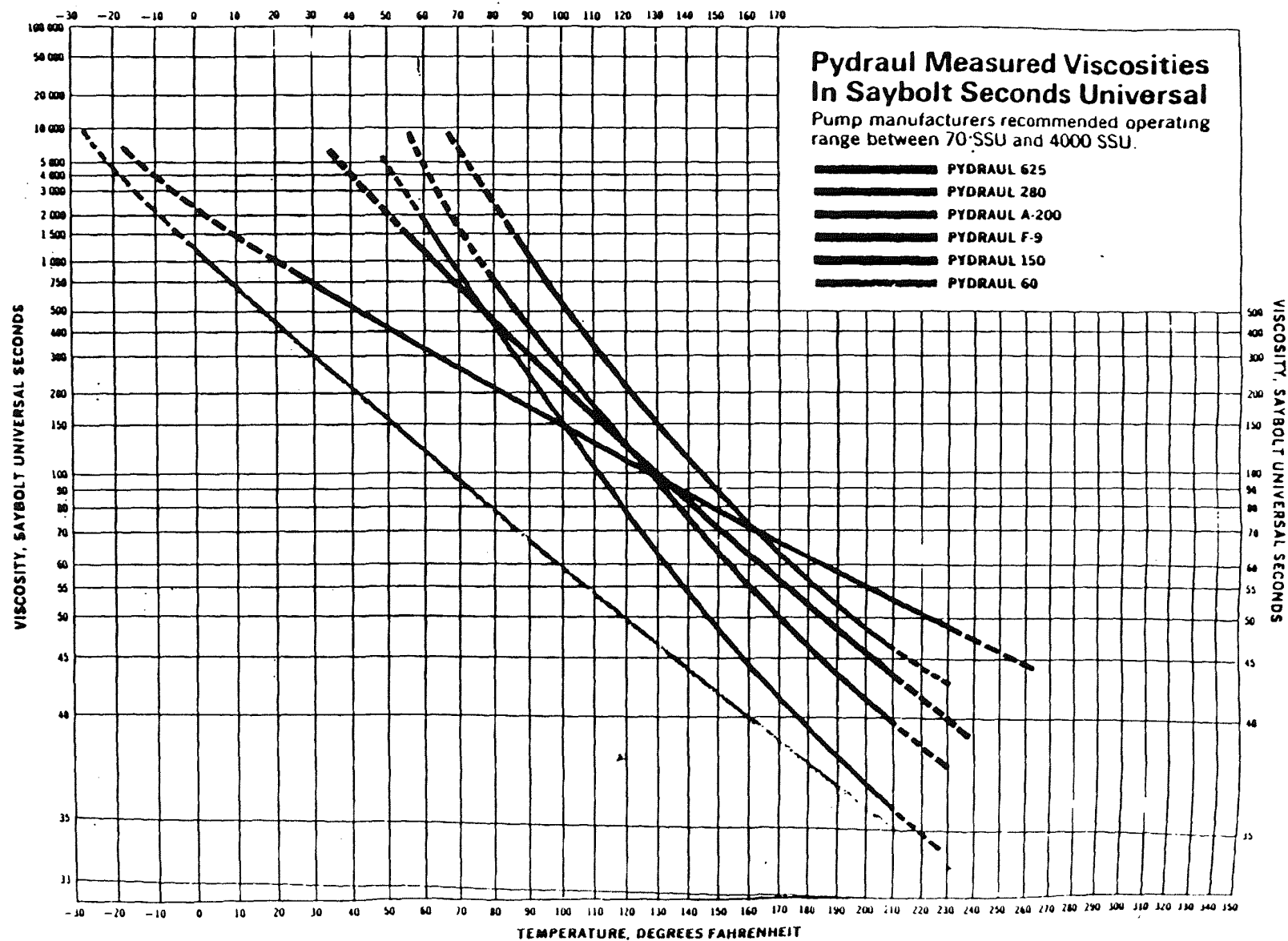
	PYDRAUL F-9	PYDRAUL A-200
PHYSICAL PROPERTIES		
Appearance	Cloudy Blue Liquid	Cloudy Blue Liquid
Spec. Gravity 25°/25°C.	1.280—1.295	1.415—1.430
Neutralization No. (acidity) (mg KOH/gm) max.	0.10—0.35	0.80—1.10
Moisture (max.)	0.20%	0.05%
VISCOSITY		
Centistokes @ 100°F.	43 to 53 cs	30.0 to 33.0 cs
210°F.	5.0 to 5.8 cs	2.8 to 3.0 cs
Saybolts ss @ 100°F.	225 SSU	144 SSU
measured: 210°F.	43.3 SSU	35.7 SSU
"Absolute Saybolts" @ 100°F.	327 SSU	204 SSU
(SSU x Density) 210°F.	52 SSU	48 SSU
Pour Point	—5°F.	+15°F.
Compressibility x 10 ⁻⁴ sq. in./lb.	2.58	2.28
Bulk Temperature Max. (for continuous operation)	225°F.	250°F.
Boiling Point °F at 760 mm Hg.	664°F.	620°F.
Coefficient of Thermal Expansion per °F.	0.00041	0.00040
Specific Heat BTU/lb./°F. @ 77°F.	0.32	0.28
Thermal Conductivity BTU/hr./ft./°F.	0.067	0.068
Vapor Pressure mm Hg @ 200°F.	0.013	0.2
Bulk Modulus (Room Temp. 1000-6000 psi)	387,000	438,000
Solubility in Water	Negligible	Negligible
FIRE RESISTANCE TEST		
High Pressure Spray Test (AMS-3150C and Federal Test Method Std. 791) Test fluid sprayed at 1000 psi through orifice, passing through flame of oxyacetylene torch, 5000°F.	Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3 feet from orifice.
Low Pressure Spray Test (AMS-3150C). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	No increase in flame intensity.	Slight increase in flame intensity.
Hot Manifold Test (Federal Test Method Std. 791). Test fluid dripped on at 1300°F.	Does not flash or burn.	Does not flash or burn.
Molten Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200°F., to test for spontaneous ignition.	Does not ignite; flashes by spark.	Does not ignite.
Fire-resistance Advantages of Pydraul Pydraul fluids protect hydraulic equipment and personnel with permanent fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their millions of hours of machine use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks—without causing fire. Pydraul fluids have never caused or contributed to a hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance.	Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is used in every major type of diecasting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer. Pydraul F-9 is listed by Underwriters Laboratories for use in hazardous hydraulic applications. It is also approved by Factory Mutual and U.S. Bureau of mines.	Pydraul A-200 is one of the widely used, general-purpose fire-resistant hydraulic fluids in industry. Introduced in 1954, it was the first fire-resistant straight synthetic hydraulic fluid to break the "price performance barrier." Pydraul A-200 performs premium-grade petroleum a wide variety of industrial applications, from die-casting to aluminum extrusion. More plants and personnel with the "inherent" fire-resistance, yet costs less than straight synthetic fluids. Pydraul A-200 is approved by Factory Mutual.

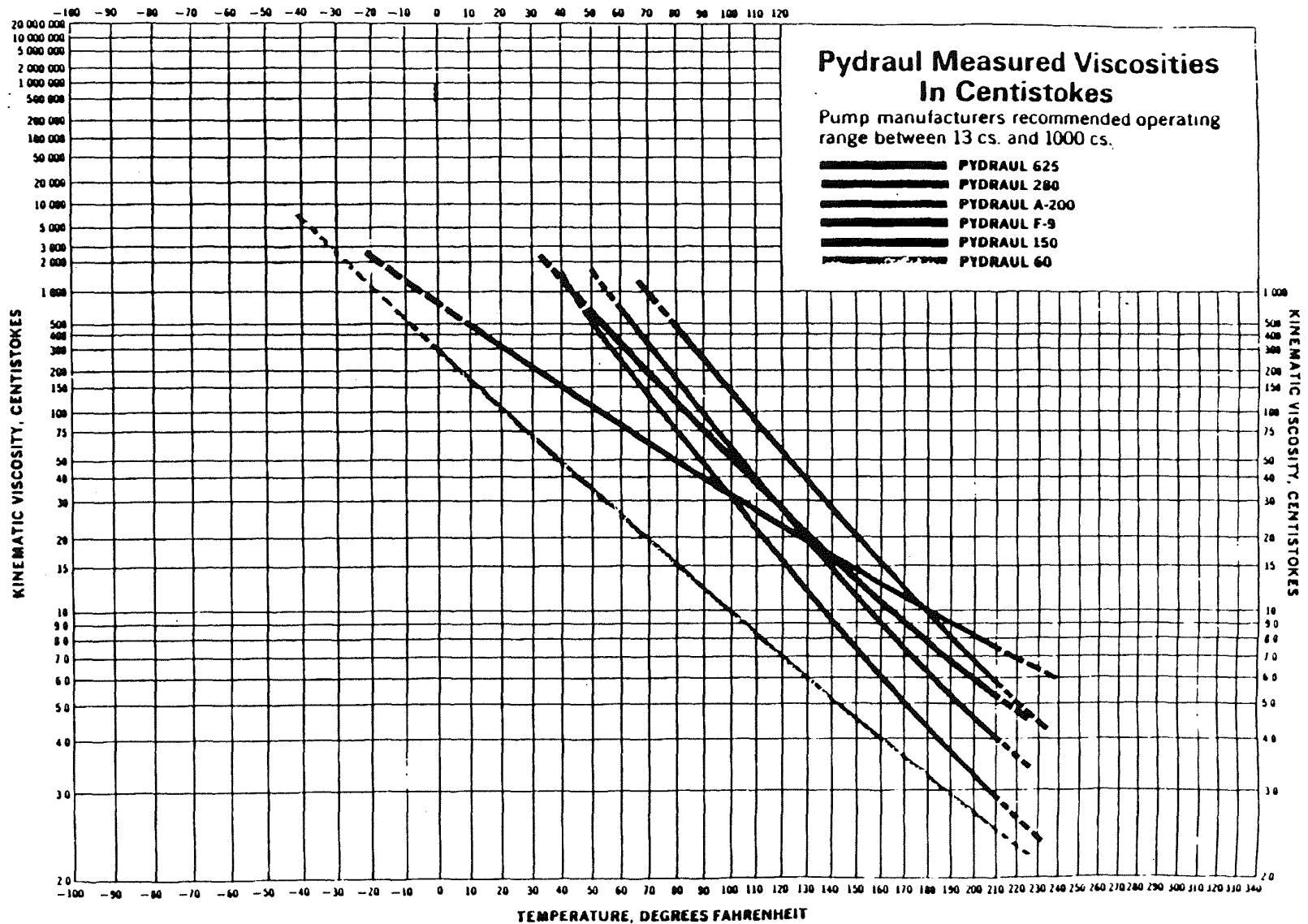
PYDRAUL 280	PYDRAUL 625	PYDRAUL 150	PYDRAUL 60
Cloudy Blue Liquid	Cloudy Blue Liquid	Cloudy Blue Liquid	Cloudy Blue Liquid
1.385—1.405	1.360—1.400	1.120—1.131	1.088—1.091
0.2—0.5	0.30	0.17	0.25
0.15%	0.15%	0.10%	0.10%
56 to 62 cs 3.9 to 4.1 cs 274 SSU 39.1 SSU 382 SSU 54.5 SSU	125 to 145 cs 5.7 to 6.2 cs 625.7 SSU 45.9 SSU 845 SSU 59 SSU	29 to 34 cs 6.9 to 8.1 cs 145.9 SSU 52.9 SSU 163 SSU 56 SSU	9.6 to 10.4 cs 2.3 to 2.5 cs 60 SSU 35 SSU 60.5 SSU 35 SSU
+20°F.	+30°F.	-55°F.	-70°F.
2.47	2.66	3.13	3.05
225°F	225°F.	150°F.	175°F
671°F.	724°F.	617°F.	707°F.
0.00040	0.00040	0.00042	0.00044
0.28	0.28	0.40	0.42
0.066	0.065	0.072	0.047
0.15	0.009	0.01	0.002
406,000	375,000	319,000	328,000
Negligible	Negligible	Negligible	Negligible
Does not flash or ignite up to 3½ feet from orifice.	Does not flash or ignite up to 3½ feet from orifice.	Self-extinguishing.	Self-extinguishing.
Very slight increase in flame intensity.	Very slight increase in flame intensity.	Slight increase in flame intensity.	Slight increase in flame intensity.
Does not flash or burn.	Does not flash or burn.	Intermittent flashing and burning. Little burning in pan below.	Intermittent flashing and burning. Does not burn after leaving tube.
Does not ignite.	Does not ignite.	Does not ignite.	Does not ignite.
Pydraul 280 is a shear stable, higher viscosity medium range safety fluid. Developed specifically for hydraulic clutches in German coal mines, Pydraul 280 has proved successful in a variety of hydraulic applications including diecasting machines and automatic welders. Blended to provide a fluid with a viscosity range between Pydraul A-200 and Pydraul 625, Pydraul 280 is now performance-proved with qualities equal to those of the long accepted Pydraul fluids. Pydraul 280 is approved by Factory Mutual.	High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SSU oil. Pydraul 625 has all the good performance characteristics which have won Pydraul fluids the reputation of quality and dependability throughout industry. In years of industrial field use, Pydraul 625 has proved to be a top-grade lubricant. Pydraul 625 is approved by Factory Mutual.	Pydraul 150 is used in hydraulic systems to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.	Low viscosity Pydraul 60 flows freely at -20°F. It retains its properties and thermal stability at temperatures up to 200°F. In hydraulic operations that require precision flow instantly, Pydraul 60 supplies smooth operation from machine start to stop; it offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

NVF 003445

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NVF 003446





NVF 003447

Pydraul Lubrication Properties

Pydraul fluids lubricate as well as premium

petroleum oil. Because of this premium lubricity, Pydraul fluids give the same long pump life as premium petroleum oil. Equipment responds at its optimum capability. And Pydraul fluids are designed to be permanent—they never evaporate or wear out.

	PYDRAUL F-9	PYDRAUL 60	PYDRAUL 150	PYDRAUL A-200	PYDRAUL 280	PYDRAUL 625
Timken Load (Passing)	50 lbs. 17,500 psi	14 lbs. 7,400 psi	40 lbs. 18,200 psi	50 lbs. 16,300 psi	53 lbs. 19,800 psi	55 lbs. 21,200 psi
Almen Wear	2.0 mg/r 4,000 psi	—	3.9 mg/r 4,000 psi	1.3 mg/r 4,000 psi	1.7 mg/r 4,000 psi	2.2 mg/r 4,000 psi
Almen Load	43 lbs. 25,000 psi	48 lbs. 25,000 psi	46 lbs. 23,000 psi	44 lbs. 24,000 psi	47 lbs. 23,500 psi	50 lbs. 23,000 psi
Falex Load—Jaw Load—Lbs. —Torque—lb. inches	4100 93	2300 73	2000 64	4200 90	4100 87	4100 89
Falex Wear (Under continuous load (r) 100 lbs., loss in inches)						
1st 10 minutes	0.000428	0.000475	0.000428	0.000380	0.000490	0.000618
2nd 10 minutes	0.000190	0.000380	0.000332	0.000380	0.000356	0.000332
Shell Four-Ball Wear (167°F. 1 hr., 630 rpm, mm scar)						
Steel on Steel						
10 kg.	0.28	0.27	0.36	0.29	0.25	0.26
40 kg.	0.67	0.48	0.51	0.43	0.52	0.62
Steel on Bronze						
10 kg.	1.18	0.82	0.80	1.40	1.25	1.10
40 kg.	1.28	2.35	1.58	1.70	1.44	1.19
Pump Test—Vickers (V-105-E, 140°F. 1000 hrs.)						
Ring, grams (loss or gain)	-0.0084	-0.0037	-0.1212	-0.0848		-0.0013
Vanes, grams (loss or gain)	-0.0011	-0.1859	-0.0378	-0.0191		-0.0015
Bushing 2015 grams (loss or gain)	+0.0120	+0.0008	-0.1601	-0.0151		-0.0045
Bushing 2016 grams (loss or gain)	-0.0063	-0.0020	-0.1134	-0.0217		-0.0050

Mixing Compatibility

PYDRAUL WITH OTHER HYDRAULIC FLUIDS

	F9	60	150	A-200	280	625
--	----	----	-----	-------	-----	-----

FYRQUEL®

	NO	YES	NO	YES	YES	YES
90	NO	YES	NO	YES	YES	YES
150	NO	YES	NO	YES	YES	YES
220	NO	YES	NO	YES	YES	YES
300	NO	YES	NO	YES	YES	YES
550	NO	YES	NO	YES	YES	YES

HOUGHTON-SAFE®

	NO	YES	NO	YES	YES	YES
1010	NO	YES	NO	YES	YES	YES
1055	NO	YES	NO	YES	YES	YES
1120	NO	YES	NO	YES	YES	YES
1130	NO	YES	NO	YES	YES	YES

Fyrquel® is a registered trademark of Sinclair Chemical Company.
Houghton-Safe® is a registered trademark of E. F. Houghton Co.

PYDRAUL WITH OTHER PYDRAUL FLUIDS

	F9	60	150	A-200	312*	280	625
F9	—	NO	YES	YES	YES	YES	YES
60	—	—	NO	YES	YES	YES	YES
150	YES	NO	—	YES	YES	YES	YES
A-200	YES	YES	YES	—	YES	YES	YES
312	YES	YES	YES	YES	—	YES	YES
280	YES	YES	YES	YES	YES	—	YES
625	YES	YES	YES	YES	YES	YES	—

WATER-GLYCOL and WATER-OIL EMULSION Fluids—Pydraul hydraulic fluids are not compatible with these fluids.

*Pydraul 312 is one of a family of new low-cost synthetic base Pydraul fire resistant fluids characterized by high performance and low cost. The other fluids in this family have the same compatibility as Pydraul 312 with other hydraulic fluids and with other Pydraul fluids. The new Pydraul fluids include Pydraul 90, Pydraul 135, Pydraul 230, Pydraul 312, Pydraul 540.

NVF 003448

Converting to PYDRAUL is Easy

Regardless of the type hydraulic fluid being used, converting a system to low-cost Pydraul fluids is easy. Virtually every type of equipment which uses fire-resistant hydraulic fluid has been converted to Pydraul fluids. Most equipment manufacturers are experienced in Pydraul fluid conversions and should be consulted.

If changing seals is necessary, equipment manufacturers can recommend what seals to change, and many carry a supply of correct seals. Laboratory tests and operational experience show Viton*, Teflon*, and silicone the preferred elastomers for compatible seals. For moderate temperatures (below 140°F) butyl seals, hose, etc. are usually acceptable. Nylon and Teflon are satisfactory for higher temperatures.

To replace other fluids which are compatible with Pydraul and where compatible seals are in the system, it is only necessary to add Pydraul as make-up fluid. It is not necessary to drain or clean. When converting from petroleum oils, non-compatible synthetic fluids, water-glycol fluids, or water-in-oil emulsions, the following steps are recommended. These conform to USA Standard B93.5—1966. For best seal performance, make your future seal selection according to recommendations on page 8 in this booklet.

Please ask the Monsanto fluids specialist for recommendations and assistance, or telephone our technical specialists in St. Louis directly (314) 694-2500.

Change-Over Procedures

CHANGING FROM PETROLEUM OIL

1. Completely drain and clean the system. Small amounts of oil will not interfere with the performance of Pydraul, but resistance to fire is reduced by the amount of oil left in the system.
2. Drain and blow out pipelines. Manually clean valves and reservoirs.

*Registered trademark of E. I. Du Pont de Nemours & Co., Inc.

3. Open or remove and drain valves. Replace gaskets, packings, and seals with those compatible with Pydraul. It is particularly important to change dynamic seals. Static seals do not necessarily have to be changed if they are not leaking. Non-compatible static seals will have to be replaced when the part is disassembled for maintenance.
4. Remove pumps, accumulators, and cylinders, if necessary, for draining. Replace packings, seals, gaskets, and bladders with those compatible with Pydraul.
5. Check component functions before the system is closed and fluid is added.
6. If your system cannot be completely drained, you may have to flush it with a small amount of Pydraul.

CHANGING FROM WATER-GLYCOL OR WATER-IN-OIL EMULSION

1. Drain and clean system thoroughly. Remove all traces of water. Empty all lines and low points or dead pockets in components.
2. Clean with steam or warm water. Follow by blowing with dry air.
3. Check sealing materials, hoses, and accumulator bags. Replace if necessary with compatible materials.
4. Install a minimum charge of Pydraul and operate the system from 16 to 24 hours. During this period, inspect the reservoir. If water or other contaminants float to the top, skim them off.
5. Drain the flushing charge immediately after shut-down while the fluid is warm. Drain all isolated points or parts which do not drain back to the reservoir. If water is apparent in fluid clinging to walls, wipe down all accessible parts.

CHANGING FROM PHOSPHATE ESTERS (OTHER THAN PYDRAUL)

1. Drain the system completely.
2. Cleaning is unnecessary.
3. Generally, seal changes are unnecessary at the time of conversion, but installation of compatible seals is recommended during routine maintenance.

NVF 003449

Seals and Packings Information

Materials compatible with Pydraul hydraulic fluid are necessary for dynamic or moving seals. For static seals they are preferred, but not essential. The following table indicates materials recommended, depending on the Pydraul fluid selected.

PYDRAUL FLUID	BUTYL	EPR	VITON	SILICONE	BUNA N	NEOPRENE	NATURAL RUBBER
A-200	M	M	R	R	U	U	U
F-9	S	S	R	R	U	U	U
150	R	R	S	R	U	U	U
625	S	S	R	R	U	U	U
280	S	S	R	R	U	U	U
60	R	R	U	S	U	U	U

R—Recommended

S—Satisfactory

M—Marginal

U—Unsatisfactory

This list of component manufacturers is a guide to obtaining seals compatible with Pydraul fluids. Please contact your equipment manufacturer or seal supplier for their most current recommendations.

Acushnet Process Company
776 Belleville Avenue
New Bedford, Massachusetts 02745

Anchor Packing Company
401 North Broad Street
Philadelphia, Pennsylvania 19108

Bearings, Inc.
3634 Euclid Avenue
Cleveland, Ohio 44115

A. W. Chesterton Company
Everett
Massachusetts 02149

Chicago Rawhide Manufacturing Company
1311 Elston Avenue
Chicago, Illinois 60622

C. E. Conover & Company, Inc.
333 Passaic Avenue
Fairfield, New Jersey 07006

Crane Packing Company
6400 Dakton Street
Morton Grove, Illinois 60053

Garlock Packing Company
Palmyra
New York 14522

Goshen Rubber Company, Inc.
P. O. Box 416
Goshen, Indiana 46526

Greene, Tweed & Company
North Wales
Pennsylvania 19454

Hercules Packing Corporation
11061 Walden Road
Alden, New York 14004

International Packing Corporation
Bristol
New Hampshire 03104

Johns-Manville
22 East 40th Street
New York, New York 10016

C. W. Marsh Company
36 Hudson Street
Muskegon, Michigan 49441

Minnesota Rubber Company
3630 Wooddale Avenue
Minneapolis, Minnesota 55416

Parker Seal Company
10567 Jefferson Boulevard
Culver City, California 90230

Plastic & Rubber Engineering, Inc.
756 East Florence Avenue
Los Angeles, California 90001

Plastic & Rubber Products Company
2100 Hyde Park Boulevard
Los Angeles, California 90047

Precision Rubber Products Corporation
Hartmann Drive
Lebanon, Tennessee 37087

Raybestos-Manhattan, Inc.
Packing Division
Passaic, New Jersey

Reliable Rubber Products
Eddington
Pennsylvania 19020

Rockwell Mechanical Packing Company, Inc.
1634 Long Beach Avenue
Los Angeles, California 90021

W. S. Shamban Company
11617 West Jefferson Boulevard
Culver City, California 90230

Vellumoid Company
Rockdale Street and Beaman Avenue
Worcester, Massachusetts 01606

The James Walker Packing Company, Inc.
P. O. Box 75
Chicago Heights, Illinois 60411

NVF 003450

Filters and Hoses

FILTERS/Most standard oil filters are satisfactory. You can use active earth or clay types. Filter manufacturers include:

Briggs Filtration Division
Bowser Corporation
Cookeville, Tennessee

Dollinger Corporation
20 Centre Park
Rochester 3, New York

Pall Corporation
32 Sea Cliff Avenue
Glen Cove, L. I., New York

Purolator Products
1000 New Brunswick Avenue
Rahway, New Jersey

Capital Engineering Company
5839 Ashland Avenue
Chicago, Illinois

Fulflo Specialties Company, Inc.
410 Fancy Avenue
Blanchester, Ohio

Rosaen Filter Corporation
1776 E. Nine Mile Road
Hazel Park, Michigan

Commercial Filters Corporation
(Honan-Crane)
Lebanon, Indiana

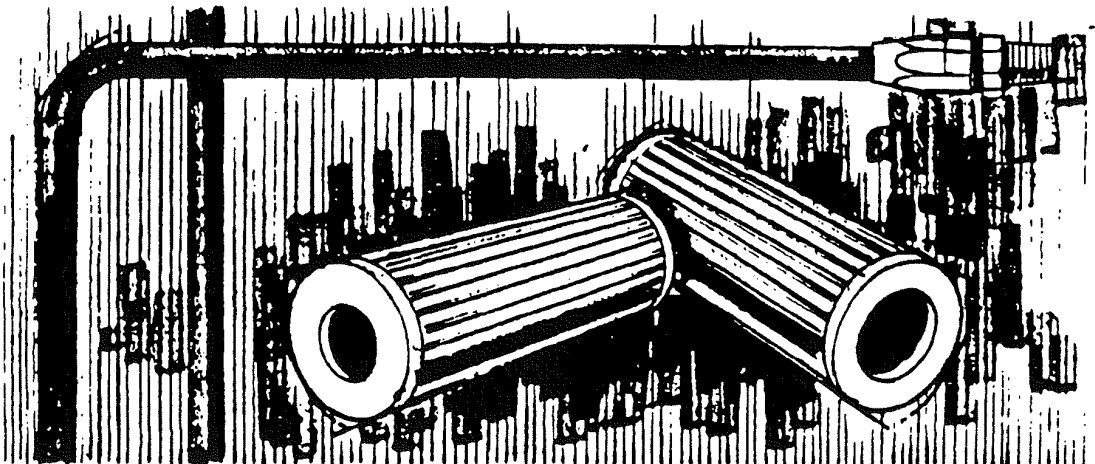
Hilliard Corporation
98 W. Fourth Street
Elmira, New York

Schroeder Bros. Corporation
101 Nichol Avenue
McKees Rocks, Pennsylvania

Cuno Engineering Corporation
Sub. of American Machine
& Foundry
4627 S. Vine Street
Meriden, Connecticut

Marvel Engineering Company
7227 North Hamlin Avenue
Chicago 45, Illinois

Serfilco Division
Service Filtration Corporation
7408 North Milwaukee
Niles, Illinois 60648



HOSES/Although both neoprene and buna elastomers swell somewhat in Pydraul, hose of these materials have given satisfactory service when made of a reinforced braid construction. Butyl, nylon or Vilon are preferred when new hoses are installed. Suppliers include:

Anaconda Metal Hose Division
Anaconda American Brass Co.
Waterbury, Connecticut 06720

Electric Hose & Rubber Co.
1201 Duro Street
Wilmington, Delaware

Lewis Products
Hohenwald, Tennessee 38462

Samuel Moore Co.
Mantua, Ohio

Anchor Coupling Company
3600 N. Fourth Street
Libertyville, Illinois

Gates Rubber Company
999 South Broadway
Denver, Colorado 80217

Resistoflex Corp.
Roseland, New Jersey

Eastman Mfg. Company
(See Imperial-Eastman Corp.)
Department T. R.
6300 West Howard Street
Chicago 48, Illinois

Imperial Eastman Corp.
6300 W. Howard Street
Chicago, Illinois

Stratoflex, Inc.
222 Roberts Cutoff Rd.
Fort Worth, Texas

Weatherhead Corp.
302 E. 131st Street
Cleveland, Ohio 44108

Other Components

SWIVEL COUPLINGS

Systems for Pydraul fluids often contain swivel couplings. Some suppliers are:

Chiksan Division
FMC Corporation
332 N. Brea Boulevard
Brea, California

PIPE JOINT SEALERS

... can be bought from:

American Sealants Company
(See Loctite Corporation)
115 N. Mountain Road
Hartford 11, Connecticut

Crane Packing Company
6410 Oakton Street
Morton Grove, Illinois

Dow Corning Corporation
Midland, Michigan

Friesland Plastics Company
Friesland, Wisconsin

General Electric Company
Insulating Materials Department
1 Campbell Road
Schenectady 6, New York

Permatex Company
Department T. R.
Flagler Court Building
West Palm Beach, Florida

W. S. Shamban & Company
11617 W. Jefferson Boulevard
Culver City, California

Shell Chemical Company
110 W. 51st Street
New York, New York

ACCUMULATORS

... many hydraulic systems for Pydraul contain an accumulator which uses a bladder to separate the fluid from air or nitrogen pressure. For these, a rubber compatible with the fluid is necessary. Suppliers include:

Greer Hydraulics, Inc.
5930 W. Jefferson Boulevard
Los Angeles, California

PAINTS

... resistant to Pydraul are supplied by:

Amercoat Corporation
Department T
Brea, California

Andrew Brown Paint Company
5413 S. District Boulevard
Los Angeles, California

Carboline Company
32-R Hanley Industrial Court
St. Louis, Missouri

Carrol Products
148 Marine Street
Farmingdale, New York

Finch Paint & Chemical Company
Torrence, California

W. P. Fuller & Company
1645 W. Valencia Drive
Fullerton, California

The Glidden Company
900 Union Commerce Building
Cleveland, Ohio

Interchemical Corporation
Finishes Division
1255-T Broad Street
Clifton, New Jersey

Lowe Brothers Company
Third & Madison Streets
Dayton, Ohio

Magna Coatings & Chemical Corporation
1785 N. Eastern Avenue
Los Angeles, California

Nycote Laboratories
15002 Delano Street
Van Nuys, California

Pittsburgh Plate Glass Company
One Gateway Center
Pittsburgh 22, Pennsylvania

Rinshed-Mason Company
5935 Milford
Detroit, Michigan

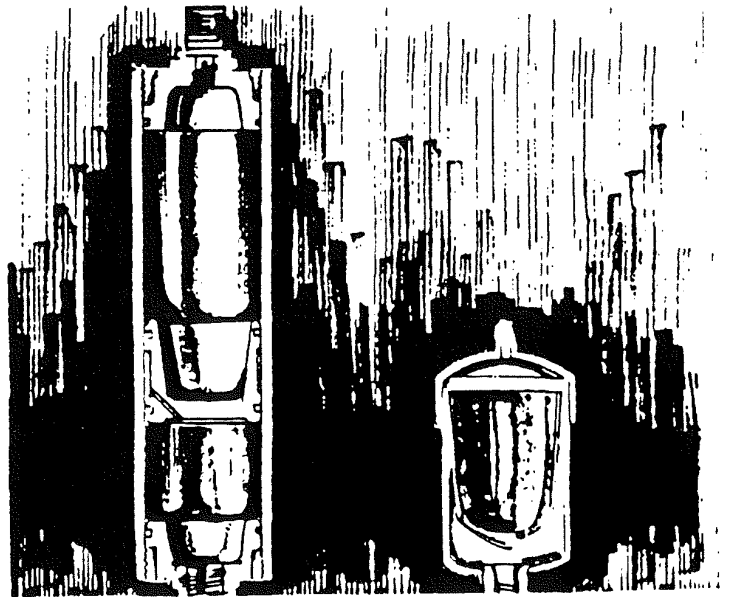
Royalty Paint & Varnish Company
Pasadena, California

Saran Protective Coatings Company
2415 Burdette at Reed
Ferndale, Michigan

Sherwin-Williams Company
101 Prospect Avenue, N. W.
Cleveland, Ohio

Titanine, Inc.
Seagrave Corporation
Elmwood & Morris Avenues
Union, New Jersey

U. S. Paint, Lacquer & Chemical Company
2101 Singleton
St. Louis, Missouri



NVF 003452

Reclaiming PYDRAUL Fluids

Pydraul hydraulic fluid lost from leaks and spills can be reclaimed because it is exceptionally stable and resistant to water and other contaminants. If fluid losses are appreciable—fluid recovery can result in considerable savings. Simply placing a container beneath leaks until they can be repaired will save some fluid. Where drip pans have been used beneath hydraulic

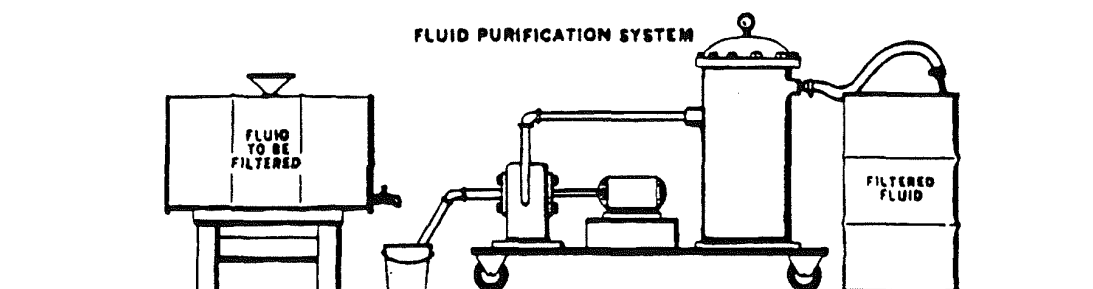
machinery, more than half of the total Pydraul leakage has been reclaimed.

This dollar-saving recovery appears especially advantageous because it isn't practical to reclaim either water glycol or water-oil emulsions except to filter out large dirt particles. Reclaiming Pydraul fluid helps make it the most economical fire-resistant fluid available.

Reclaiming Pydraul consists of two steps: removing water, and filtering dirt or other solid particles.

WATER REMOVAL... Water does not mix with Pydraul and will, therefore, form a layer on top. A drum reserved for contaminated fluid with a side and end bung, placed horizontally on a cradle about two feet off the floor, is a simple

and effective settling chamber. Salvaged fluid can be added through a large funnel in the top opening and Pydraul periodically drained off through the lower opening.

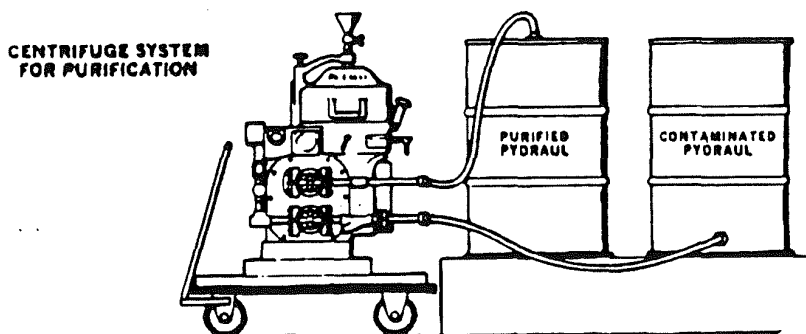


For a more elaborate system, permanently installed settling tanks, or a commercial installation can be used.

A second method is centrifuging. Suitable units are made by DeLaval and Sharples Co. Centrifuges operate swiftly . . . will separate water from large volumes of fluid in a short time.

FINAL FILTRATION . . . A number of filtration units are available complete with filter pump

and motor. Other systems use filter media such as cotton linters, felt or metal screens. Attapulga clay and Fuller's earth may be used to help keep the fluid clean, reduce moisture and lower neutralization number. Diatomaceous earth filtration is recommended for solid particles removal only. Paper and fiber type filters are recommended for water and particle removal but are ineffective for lowering neutralization number (acidity) values.



Filters in the 3 to 5 micron range are recommended for Pydraul filtration and reclamation. Such filter media will not affect the basic Pydraul formulation.

Handling

Animal toxicity studies and human experience indicate that the Pydraul hydraulic fluids may be used safely if a few reasonable precautions are taken. Repeated or prolonged skin contact should be avoided not only to prevent absorption of the material and possible systemic effect but, also, because the fluids are excellent solvents for the oils normally present in the skin. Thus, drying and irritation could occur.

When splashed or sprayed into the eyes, Pydraul causes painful smarting. There is no evidence, however, of any permanent eye injury. In the event of accidental contact with the eyes, the eyes should be flushed with copious amounts of water for 15 minutes and the workman referred to a physician; physicians have used 1% Pontocaine solution and ophthalmic cortisone acetate solution to relieve irritation.

When Pydraul is kept at room temperature, it does not constitute a vapor inhalation hazard except in a confined, unventilated space. Respiratory protection or mechanical exhaust ventilation should be provided if there is repeated and prolonged contact of the fluid with heated surfaces with resulting volatilization or possible decomposition of the fluid. Where a ruptured oil hydraulic line near a white-hot surface means a fire, a ruptured hydraulic line containing Pydraul causes a vapor with an unpleasant odor that can help you locate the trouble. For short periods, such as turning off equipment following the rupture of a hydraulic line or other mechanical failure, no protection is necessary.



NVF 003454

DISTRICT SALES OFFICES ALL DIVISIONS

AKRON, OHIO 44313
260 Springside Drive
Montrose Development Park
Tel. (216) 666-4111

ATLANTA, GEORGIA 30326
Lenox Towers East
3400 Peachtree Rd. N. E.—Suite 1711
Tel. (404) 577-2260

BOSTON, MASSACHUSETTS 02149
Everett Station
Tel. (617) 387-5010

CHICAGO, ILLINOIS
3158 Des Plaines Ave.
Des Plaines, Illinois 60018
Tel. (312) 296-6688

CINCINNATI, OHIO 45206
1501 Madison Road
Tel. (513) 751-6707

DETROIT, MICHIGAN 48235
500 Northland Towers East
Tel. (313) 357-0910

HONOLULU, HAWAII 96812
205 Pacific International Bldg.
677 Ala Moana Blvd., P.O. Box 3824
Tel. (808) 531-2744

HOUSTON, TEXAS 77002
1300 Main Street
Tel. (713) 223-4011

LOS ANGELES, CALIFORNIA 90022
6670 E. Flotilla St.
Tel. (213) 723-2492

NEW YORK, NEW YORK 10017
277 Park Avenue
Tel. (212) 922-4111

ST. LOUIS, MISSOURI 63166
800 N. Lindbergh Blvd.
Tel. (314) 694-1000

SAN FRANCISCO BAY AREA
2710 Lafayette, Santa Clara, Calif. 95052
Tel. (408) 243-0414

SEATTLE, WASHINGTON 98104
911 Western Avenue
Tel. (206) 622-4203

SPRINGFIELD, MASSACHUSETTS 01101
730 Worcester Ave.
Tel. (413) 788-6911

WILMINGTON, DELAWARE 19803
2005 Concord Pike, Fairfax
Tel. (302) 658-6531

Agricultural Division
ALLENTOWN, PENNSYLVANIA 18104
Park Professional Building
2200 Hamilton Street
Tel. (215) 437-5471

DES MOINES, IOWA 50310
312 Marie Hay Tower
Tel. (515) 276-8503

FREMONT, NEBRASKA 68025
150 South Main Street
Tel. (402) 727-1230

INDIANAPOLIS, INDIANA 46205
Suite 218, 4000 Meadows Drive Building
Tel. (317) 547-9148

LULING, LOUISIANA 70070
P. O. Box 174
Tel. (504) 784-6263

MANKATO, MINNESOTA 56001
111 Madison East
Tel. (507) 387-3406

MEMPHIS, TENNESSEE 38104
303 Union Plaza Bldg.
Tel. (901) 278-7811

MUSCATINE, IOWA 52761
P. O. Box 473
Tel. (319) 263-1331

**Hydrocarbons & Polymers
Division-Lion Oil**
EL DORADO, ARKANSAS 71730
Lion Oil Building
Tel. (501) 863-3111

JACKSON, MISSISSIPPI 39209
P. O. Box 10937, Westland Station
Tel. (601) 352-3648

N. LITTLE ROCK, ARKANSAS 72119
410 West 8th Street, P. O. Box 5821
Tel. (501) 376-2437

MEMPHIS, TENNESSEE 38113
1023 Riverside Drive, P. O. Box 13248
Tel. (901) 948-4451

**Organic Division
(Rubber Instruments)**
AKRON, OHIO 44311
920 Brown Street, P. O. Box 2307
Tel. (216) 434-1962

**Plastic Products & Resins
Division**
KENILWORTH, NEW JERSEY 07033
North Seventh St. & Monroe Ave.
Tel. (201) 276-2900

Textiles Division
ATLANTA, GEORGIA 30303
Atlanta Merchandise Mart
240 Peachtree St., N. W.
Tel. (404) 577-2280

CHARLOTTE, NORTH CAROLINA 28210
6230 Fairview Road, Suite 400
Tel. (704) 364-0110

GREENVILLE, SOUTH CAROLINA 29606
McAllister Plaza
P. O. Box 5564, Station B
Tel. (803) 239-9171

NEW YORK, NEW YORK 10001
350 Fifth Ave.
Tel. (212) 556-5100

Monsanto

Monsanto Company / Functional Fluids / 800 North Lindbergh Blvd. / St. Louis, Missouri 63166

NVF 003455

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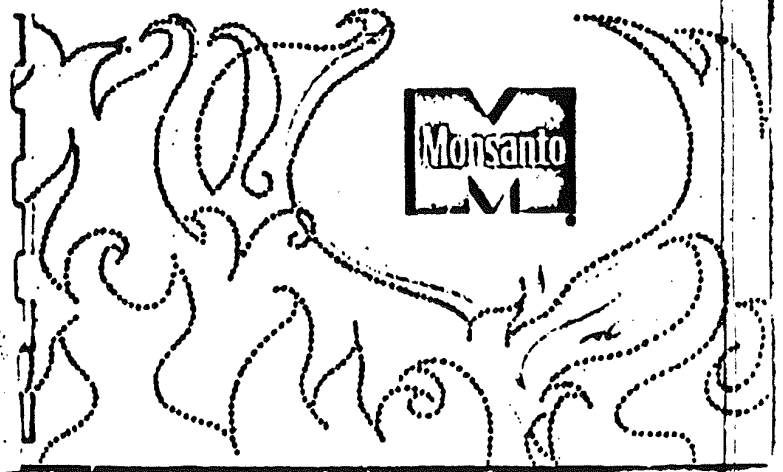
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PYDRAUL.
FIRE-RESISTANT HYDRAULIC FLUID
SELECTOR



NVF 003481

PYDRAUL

SELECTOR

NVF 003482

THE PYDRAUL SELECTOR

...is designed to put literally at your fingertips all the facts about Pydraul fire-resistant hydraulic fluids—to guide you quickly to the Pydraul fluid that will serve your operation best.

Protection from fire for hydraulic operations began with Pydraul. That was in 1961. Pydraul fluids have since served industry with over one billion machine hours of fire-free operation. Never during these billion hours of machine operations has a Pydraul fluid contributed to a fire—not even when sprayed from the broken ends of high pressure hydraulic lines onto white-hot surfaces.

New ways are continuously being explored to improve the excellent performance records of Pydraul fluids. The first Pydraul fluid, general-purpose Pydraul F-9, has grown to a family of six, specially tailored, fire-resistant hydraulic fluids and lubricants. Each answers a major but specific hydraulic fluid need for industrial use. In addition to guarding against fire, each Pydraul fluid lubricates as well as premium grade oil. Pydraul fluids have answered the need of virtually every industrial hydraulic operation, indoors and out—from the sub-zero, outdoor hydraulic lift operations for refineries and blast furnaces to the low-viscosity fluid demands of high-speed, precision machine tools.

NVF 003483

PYDRAUL PERFORMANCE

The six fire-resistant, premium-lubricating Pydraul fluids offer a wide range of viscosities from which you can select the proper level specified by your hydraulic equipment manufacturer. Whichever Pydraul fluid you select, each provides the same protection against fire, premium lubricity, ease of maintenance, and freedom from corrosive action and foam. Pydraul hydraulic fluids also offer several additional benefits—

REDUCED FIRE INSURANCE RATES

Because Pydraul eliminates fire hazards from hydraulic equipment operations, Pydraul reduces the threat of fire to surrounding structure and equipment. Insurance premiums for plants using Pydraul, therefore, are often lower than premiums for operations using petroleum oil.

LONGER PUMP LIFE

Machines that operate on water-based fluids frequently require pump repair or replacement as often as every two or three months. Machines that use Pydraul hydraulic fluids can operate on the same pump for several years. Pydraul hydraulic fluids give the same long pump life as the finest grade petroleum oil.

NVF 003484

NO CORROSION PROBLEMS

Any metal hydraulic system component in contact with Pydraul will not rust. And Pydraul hydraulic fluids do not lose anti-rust properties with use.

MAXIMUM EQUIPMENT RESPONSE

Pydraul never produces excessive froth or foam during normal operations to interfere with hydraulic equipment response. Because Pydraul hydraulic fluids lubricate as well as premium petroleum oils, Pydraul permits equipment to operate at optimum response capability.

INSPECTION AND REPLACEMENT

DOWN-TIME ARE VIRTUALLY ELIMINATED

Pydraul hydraulic fluids are designed to be permanent. Pydraul fluids do not wear out. Except for normal "make-up" requirements, you never have to add new Pydraul to hydraulic systems. Pydraul eliminates "drain and change" periods; it does not have to be inspected in your system from month to month—or even replaced from year to year.

NVF 003485

CONTRACT NO.

SELECTOR

NVF 003486

PYDRAUL

60

Low viscosity Pydraul 60 flows freely at -20° F. It retains its properties and thermal stability at temperatures up to 200° F. In hydraulic operations that require precision flow instantly, Pydraul 60 supplies smooth operation from machine start to stop; it offers flow-on-demand operation without hydraulic lag. Pydraul 60 offers excellent, fire-resistant, hydraulic operation with vane, gear and piston pumps in high-speed machine tools.

FIRE-RESISTANCE TESTS

Pydraul fluids protect hydraulic equipment and personnel with permanent fire protection. Pydraul fluids contain no water to evaporate and leave a flammable residue. During their more than one billion machine hours of use, Pydraul fluids have been accidentally sprayed over molten metal, through electrical arcs, into flames and sparks—without causing fire. Pydraul fluids have never caused or contributed to an hydraulic fire in any type of equipment. They pass all of the important ignition tests for fire-resistance, as shown by these test results:

Physical Properties

Appearance

Spec. Gravity 25°/25°C

Neutralization No.
(acidity) (mg KOH/gm) max.

Moisture (max.)

Viscosity

As measured: 100° F.

210° F.

"Absolute Saybolt" 100° F.

(SSU X Density) 110° F.

Pour Point

Compressibility X10⁻⁴

in./in.

Boil Temperature Max.

Boiling Point

°F at 760mm Hg.

Coefficient of Thermal

Expansion per ° F.

Specific Heat

(BTU/lb./° F.) (@ 77° F.)

Thermal Conductivity

BTU/in./ft./° F.

Vapor Pressure

Hg @ 200° F.

Both Modulus / Room Temp.

1000-4000

psi

Solubility in Water

Test

High Pressure Spray Test
(AMS-3180B and MIL-F-7100). Test fluid sprayed at 100 psi through orifice, passing through flame of oxyacetylene torch, 6000° F.

Low Pressure Spray Test
(AMS-3180B). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.

Hot Metal Test
(MIL-F-7100). Test fluid dripped on tube at 1200° F.

Medium Metal Ignition Test
Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.

NVF 003487

150

PYDRAUL 150

Pydraul 150 is currently used in more than seven hundred G. P. E. (formerly Askania) regulators to control fuel-to-air ratios for blast furnaces, soaking pits, and other similar related equipment. Although developed especially for severe cold-weather, outdoor operations, Pydraul 150 is also used for certain missile-launch projects and in gears of LOX pumps located in oxygen-rich atmospheres at missile-fueling sites. Pydraul 150 also performs as an excellent low-viscosity fluid for high-speed machine tools.

NVF 003488

Physical Properties

Appearance

Spec. Gravity 15°/25°C

Neutralization No.
(Acidity) (mg KOH/gm) max.

Moisture (max.)

Viscosity
As measured: 100° F.
210° F.
"Absolute Saybolt" 100° F.
(SSU X Density) 210° F.

Pour Point

Compressibility X10⁻⁴
sq. in./lb.

Bulk Temperature Max.

Boiling Point
°F at 760mm Hg.

Coefficient of Thermal
Expansion per ° F.

Specific Heat
(BTU/lb./° F.) (@ 77° F.)

Thermal Conductivity
BTU/hr./ft./° F.

Vapor Pressure
Hg @ 200° F.

Bulk Modulus / Room Temp.
(1000-6000
psi)

Solubility in Water

Tests

High Pressure Spray Test
AMS-31600 and MIL-F-
7100. Test fluid sprayed at
100 psi through orifice,
passing through flame of
oxyacetylene torch, 6000° F.

Low Pressure Spray Test
(AMS-31600). Test fluid
sprayed at low pressure
over ignited, oil-soaked rag
to determine degree of
increase in flame intensity.

Hot Metal Test
(MIL-F-7100). Test fluid
dropped on tube at 1300° F.

Wetted Metal Ignition Test.
Test fluid exposed to the
surface of aluminum alloy
at 1200° F., to test for
spontaneous ignition.

NVF 003489

150 A-200

PYDRAUL
A-200

Pydraul A-200 is one of the most widely used, general-purpose, fire-resistant hydraulic fluids in industry. Introduced in 1959, it was the first fire-resistant, straight synthetic hydraulic fluid to break the "price/performance barrier." Where protection from fire is the maximum consideration, Pydraul A-200 offers the lowest cost per gallon of straight synthetic, fire-resistant hydraulic fluids.

NVF 003490

Physical Properties
Appearance
Spec. Gravity 75°/25°C
Neutralization No. (acidity) (mg KOH/gm) max.
Moisture (max.)
Viscosity As measured: 100° F. 210° F. "Absolute Saybort" 100° F. (SSU X Density) 210° F.
Pour Point
Compressibility X10 ⁻⁴ sq. in./lb.
Soft Temperature Max.
Boiling Point °F at 760mm Hg.
Coefficient of Thermal Expansion per ° F.
Specific Heat (BTU/lb./° F.) (@ 77° F.)
Thermal Conductivity BTU/hr./ft./° F.
Vapor Pressure Hg @ 299° F.
Soft Modulus / Room Temp. (1000-8000 psi)
Solubility in Water
Test
High Pressure Spray Test AMS-31000 and MIL-F- 7194. Test fluid sprayed at 100 psi through orifice, passing through flame of oxyacetylene torch, 5000° F.
Low Pressure Spray Test (AMS-31000). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.
Hot Monfield Test (MIL-F-7194). Test fluid dripped on tube at 1300° F.
Mothers Metal Ignition Test. Test fluid exposed to the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.

NVF 003491

150 A-200 F-9

PYDRAUL F-9

Monsanto introduced Pydraul F-9 as industry's first straight synthetic, fire-resistant hydraulic fluid. Pydraul F-9 rapidly became the standard against which all other synthetic hydraulic fluids were judged. Today, it is still considered the basis for comparison. Pydraul F-9 is now used in every major type of die-casting machine and a wide variety of other equipment found in the metal-working, glass, and process industries. No other fire-resistant hydraulic fluid has more on-the-line proven performance to offer.

NVF 003492

Physical Properties

Appearance

Spec. Gravity 25°/25°C

Neutralization No.
(acidity) (mg KOH/gm) max.

Moisture (max.)

Viscosity

As measured: 100° F.
210° F.

"Absolute Saybolt" 100° F.
(SSU X Density) 210° F.

Pour Point

Compressibility X10⁻⁴
sq. in./in.

Boil Temperature Max.

Boiling Point
°F at 760mm Hg.

Coefficient of Thermal
Expansion per ° F.

Specific Heat
(BTU/lb./° F.) (20° F.)

Thermal Conductivity
BTU/hr./ft./° F.

Vapor Pressure
Hg @ 200° F.

Boil Modulus (Room Temp.)
1000-6000
psi

Solubility in Water

Test

High Pressure Spray Test
AMS-3100B and MIL-F-
7100. Test fluid sprayed at
100 psi through orifice,
penetrating through flame of
oxyacetylene torch, 6000° F.

Low Pressure Spray Test
(AMS-3100B). Test fluid
sprayed at low pressure
over ignited, oil-soaked rag
to determine degree of
increase in flame intensity.

Hot Blanket Test
(MIL-F-7100). Test fluid
dripped on tube at 1300° F.

Wetted Metal Ignition Test.
Test fluid exposed to the
surface of aluminum alloy
at 1200° F., to test for
spontaneous ignition.

NVF 003493

150 A-200 F-9 825

PYDRAUL
625

High viscosity Pydraul 625 is tailored for ultra-heavy-duty hydraulic operations, such as for large industrial presses and pumps. Pydraul 625 is also used as a fire-and-explosion-resistant air compressor lubricant. Pydraul 625 can be used in any equipment requiring an 800 to 1000 SUS oil.

NVF 003494

Physical Properties
Appearance
Spec. Gravity 75°/75°C
Refractive Index
(density) (mg AOW/gm) max.
Moisture (max.)
Thermal
At Distilled: 100° F.
210° F.
"Absolute Zero" 100° F.
(SDU X Density) 210° F.
Free Point
Compressibility 110°
at 100° F.
Boil Temperature Max.
Boiling Point
at 760mm Hg.
Coefficient of Thermal
Expansion per ° F.
Specific Heat
(BTU/lb. ° F.) @ 77° F.)
Thermal Conductivity
BTU/hr. ft. ° F.
Vapor Pressure
Hg @ 100° F.
Boil Modulus (from Test)
1000-5000
sol
Solubility in Water
Test
High Pressure Spray Test
ASTM-1100 and 1111-2.
7100 Test fluid sprayed at
100 psi through orifice.
passing through range of
viscosity test. 6000° F.
Low Pressure Spray Test
(ASTM-1100). Test fluid
sprayed at low pressure
and ignited. At each 100
in increments degree of
intensity in 2 sec intervals.
Hot Modulus Test
(ASTM-1100). Test fluid
dropped on tube at 1000° F.
Minimum Metal Ignition Test.
Test fluid sprayed in the
surface of aluminum alloy
at 1000° F. in test for
metallic ignition.

NVF 003495

150 A-200 F-9 625

PYDRAUL AC

A special safety lubricant for air compressors. Pydraul AC offers three important advantages over petroleum oils: safety from flash fires; virtually no valve deposits, and lower maintenance costs. By eliminating combustible mists and minimizing carbonaceous residues, Pydraul AC reduces the threat of compressor fires and explosions. Pydraul AC also reduces compressor maintenance costs. By eliminating deposits on exhaust valves, in coolers, and in piping, Pydraul AC greatly reduces the costs of compressor down-time and cleaning. These lower maintenance costs alone usually justify Pydraul AC for air compressors.

NVF 003496

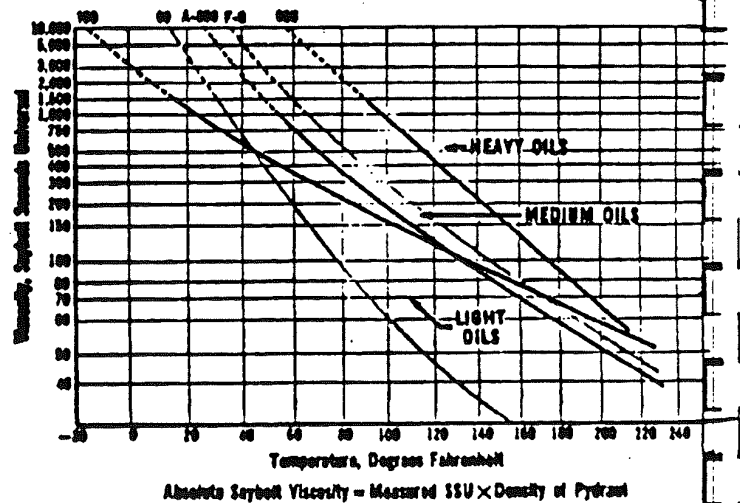
PTORAU 825				PTORAU A-200			
Physical Properties				Physical Properties			
Appearance	Clear Drop Liquid	Cloudy Drop Liquid	Cloudy Drop Liquid	Cloudy Drop Liquid			
Spec. Gravity 25°/75°C (density) (mg KCH/gm) max.	1.340-1.349	1.340-1.370	1.276-1.300	1.415-1.430			
Refractive Index (density) (mg KCH/gm) max.	0.15	0.30	0.30	0.30-0.10			
Moisture (max.)	0.15%	0.15%	0.20%	0.20%			
Viscosity As measured: 100° F. 210° F. "Aluminum Sulfate" 100° F. (SSU X Density) 210° F.	400.0 SSU 42.1 SSU 640 SSU 50 SSU	475.7 SSU 42.3 SSU 527 SSU 50 SSU	275 SSU 42.3 SSU 527 SSU 50 SSU	144 SSU 35.7 SSU 704 SSU 48 SSU			
Pour Point	+20° F.	+20° F.	-10° F.	+10° F.			
Compressibility X10 ⁴ at 100 lb.	2.66	2.66	2.50	2.50			
Boil Temperature Max.	300° F.	300° F.	300° F.	300° F.			
Boiling Point at 760 mm Hg.	600° F.	720° F.	640° F.	620° F.			
Coefficient of Thermal Expansion per ° F.	0.00040	0.00040	0.00041	0.00040			
Specific Heat (BTU/lb., ° F.) @ 77° F.	0.12	0.20	0.20	0.20			
Thermal Conductivity BTU/hr./ft., ° F.	0.005	0.005	0.007	0.007			
Vapor Pressure Hg @ 200° F.	0.00000	0.00000	0.00000	0.00000			
Boil Residue (Norm Temp. 1000-4000 psi)	375,000	375,000	307,000	310,000			
Solubility in Water	Negligible	Negligible	Negligible	Negligible			
Test	PTORAU 825	PTORAU 825	PTORAU P-2	PTORAU A-200			
High Pressure Spray Test (ASTM-31500 and MIL-P- 1000. Test fluid sprayed at 100 psi through orifice. 100 psi through orifice. 100 psi through orifice.	Does not flash or ignite up to 314 psi from orifice.	Does not flash or ignite up to 314 psi from orifice.	Does not flash or ignite up to 314 psi from orifice.	Does not flash or ignite up to 314 psi from orifice.			
Low Pressure Spray Test (ASTM-31500). Test fluid sprayed at low pressure over ignited, oil-soaked rag to determine degree of increase in flame intensity.	Very slight increase in flame intensity.	Very slight increase in flame intensity.	No increase in flame intensity.	Slight increase in flame intensity.			
Hot Metalfield Test (ASTM-21100). Test fluid dropped on tube at 1200° F.	Does not flash or burn.	Does not flash or burn.	Does not flash or burn.	Does not flash or burn.			
Medium Metal Ignition Test. Test fluid sprayed in the surface of aluminum alloy at 1200° F., to test for spontaneous ignition.	Does not ignite.	Does not ignite.	Does not ignite. Flashes by spurt.	Does not ignite.			

NVF 003497

PYDRAUL VISCOSITIES

Laboratory viscosity measurements of SSU (Saybolt Seconds Universal) are affected by fluid density. Because all petroleum oils used for hydraulic operations have similar densities, their measured viscosities can be compared; however, the densities of synthetic fluids differ from one another and from petroleum oils. To compare viscosities, measured viscosities of synthetic fluids must be corrected for density.

On the chart below, each curve for a Pydraul fluid shows the viscosity-temperature relationship modified for the difference in density of the indicated Pydraul fluid. By comparing these curves with viscosity curves of light, medium, and heavy grades of petroleum oils, it can be seen that Pydraul fluids virtually duplicate viscosities of petroleum oils at normal operating temperatures.



NVF 003498

CONVERTING TO PYDRAUL IS EASY

How to convert existing equipment.

No matter what type of hydraulic fluid you now use in your equipment, you can easily convert to Pydraul. Virtually every type of hydraulic machinery requiring a fire-resistant hydraulic fluid has been converted to Pydraul. Equipment manufacturers are experienced in converting machinery to Pydraul and should be consulted for their specific recommendations. Some manufacturers will tell you exactly what seals to change. Most can supply the correct seals.

Machines operating on a *straight synthetic*, fire-resistant fluid can be converted to Pydraul without interrupting your production. When converting to Pydraul A-200, Pydraul 625, or Pydraul AC, simply add Pydraul as make-up. To convert to other Pydraul fluids, drain the old fluid and refill with the Pydraul fluid. No flush is necessary.

Machines operating on oil or water-based hydraulic fluids require the few simple steps outlined below. These steps are necessary to clean the system of the old fluid and to change to dynamic seals compatible with Pydraul.

Check for leaks.

Check the entire system before the equipment is shut down for conversion. Mark these leaks for later correction.

Drain fluid from the system.

Drain the reservoir, lines, and cylinders as completely as possible to remove all of the old fluid. This can sometimes be done by opening unions at low spots in the system and blowing with clean air.

VISCOSITIES
CONVERTING

NVF 003499

Clean reservoir and filters.

Remove interior paint from the reservoir (if painted) by scraping or with a commercial paint remover. Wipe clean with lint-free rags. Clean or change the cartridge in the filter.

Check pumps for wear. Replace any part of the pump assembly that shows serious wear.

Install seals and packings compatible with Pydraul.

Dynamic seals should be changed. Reinforced-type hoses are normally satisfactory with Pydraul and need not be replaced if they are in good condition. In operations where severe hose flexing and bending take place, butyl-lined hoses are recommended. Accumulator diaphragms should be made of butyl, Viton, or other materials resistant to Pydraul.

Reconnect lines.

When reconnecting lines, tighten carefully—particularly those joints that leaked previously. Then fill with Pydraul to the proper level.

Start and stop pump.

With the hydraulic controls in neutral, start and stop the pump several times, but do not allow the system to reach working pressure. This will help assure that fluid reaches the pump and lubricates it. The pump can then be left on, and the system can be brought to working pressure.

Run through the cycle.

Run through the cycle several times to use all parts of the hydraulic system. Bleed any trapped air through the petcocks or valves. Check the fluid level and add Pydraul if necessary.

How to equip new machinery with Pydraul.

When ordering new hydraulic equipment, simply specify, "For use with Pydraul hydraulic fluid."

NVF 003500

HANDLING AND STORAGE

As with all specialized industrial fluids, certain precautions are advisable when handling Pydraul fluids. No problems will arise when Pydraul fluids are used as recommended.

Avoid repeated or continuous skin contact. Repeated or prolonged contact can lead to drying and skin "chapping." Where prolonged skin contact cannot be avoided, gloves should be worn.

At room temperatures, there is no vapor inhalation hazard from Pydraul; however, inhalation of vapors at high temperatures should be prevented. In extensive animal experimentation, exposures to vapors for one hour showed local respiratory irritation, although no systemic effects were produced.

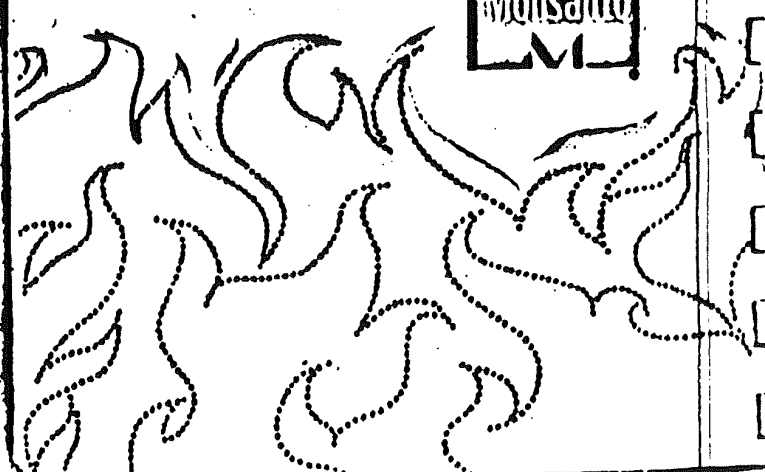
Although eye irritation studies using Pydraul at full strength indicate Pydraul is a mild irritant, there is no evidence to show Pydraul causes permanent damage to eye tissues. If Pydraul fluid is splashed or sprayed into the eyes, eyes should be thoroughly flushed with water and the workman referred to a physician. To relieve irritation, physicians have used 1% pontocaine solution, as well as the ophthalmic cortisone acetate solution.

Pydraul hydraulic fluids can be stored at sub-zero temperatures without fluid damage. Before using, simply allow the fluid to warm to room temperature. Drums stored outside should be sealed tightly and placed in a horizontal position to keep out moisture.

HANDLING

NVF 003501

St. Louis, Mo. 63166



NVF 003502

Here's how

CONVERT



PYDRAUL

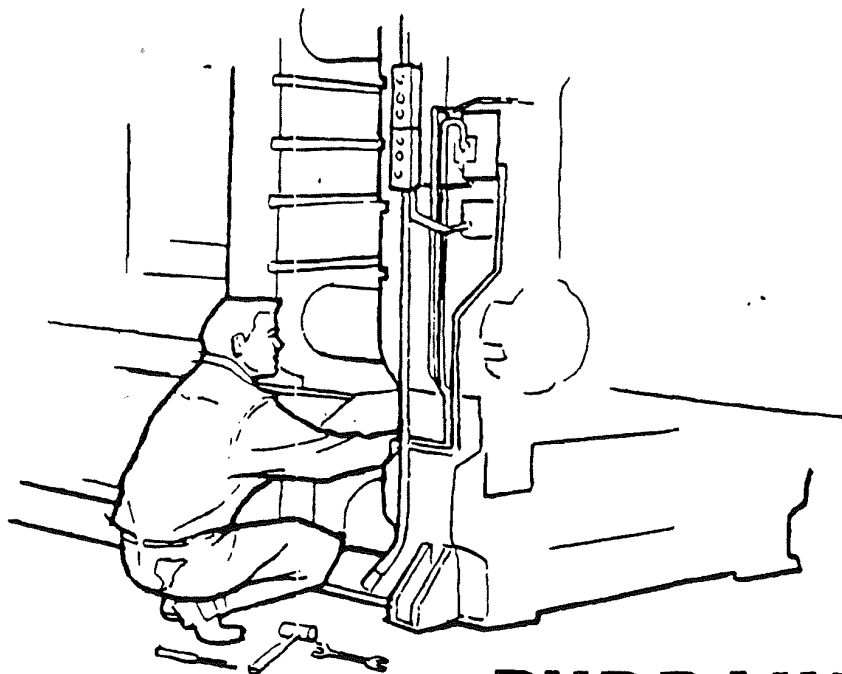
DOUBLE ACTION

FOR
PUMP ACTION
MAINTENANCE

Monsanto

NVF 003503

Product of Monsanto T.M. Reg. U.S. Pat. Off.



converting to **PYDRAUL** *is easy!*

You can convert to Pydraul straight synthetics no matter what type of hydraulic fluid you now use in your equipment—nearly every type of hydraulic equipment that needs a fire-resistant fluid has been converted to Pydraul. Equipment manufacturers are experienced in conversion procedures and should be consulted for their recommendations. Some manufacturers will tell you exactly what seals to change and several will supply them. You can use the check list on the opposite page as a general guide for converting hydraulic systems to any Pydraul fluid.

For machines now running on a straight synthetic fluid, you can add Pydraul A-200 or Pydraul 625 as make-up without interrupting your production. Machines operating on oil or water-based fluids require a few simple conversion steps which primarily involve cleaning the system of the old fluid and changing dynamic seals to resistant materials.

NVF 003504

CHECK FOR LEAKS

Check the entire system for leaks before you shut it down for conversion. Mark these for correction later.

DRAIN FLUID FROM SYSTEM

Drain the reservoir, lines and cylinders as completely as possible to remove all the previous fluid. Sometimes this can be done by opening unions at low spots in the system and blowing clean with air.

CLEAN RESERVOIR AND FILTERS

Remove interior paint from the reservoir (if it is painted) by scraping or with a commercial paint remover. Wipe it dry with clean rags which are lint free. Clean or change the cartridge in the filter.

Pydraul fluids can be used to flush systems, too, since they will loosen tars, varnish and residues left by previous fluids. Filters will remove these contaminants. If there is no filter or if parts of equipment are difficult to reach for cleaning, a portable filter can be connected to the system and left on stream for the first two or three days of operation.

CHECK PUMPS FOR WEAR

Replace any parts of the pump assembly that show serious wear—especially important if the machine has operated on water-based fluids.

..... Just follow these steps

INSTALL RESISTANT SEALS AND PACKINGS

Some Pydraul users have converted without changing seals and changed them at later maintenance checks. Usually dynamic seals should be changed to a resistant material. Non-resistant static seals will swell in Pydraul and make a tighter seal; the swelled seal can be replaced with a new one when the joint is later disassembled for other reasons. At normal hose replacements, use hoses with a butyl lining. Use butyl rubber bladders for accumulators.

RECONNECT LINES

When you reconnect the lines, tighten them carefully—particularly those joints that previously leaked. Then fill with Pydraul to the proper level.

START AND STOP PUMP

With the hydraulic controls on neutral, start and stop the pump several times without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system to working pressure.

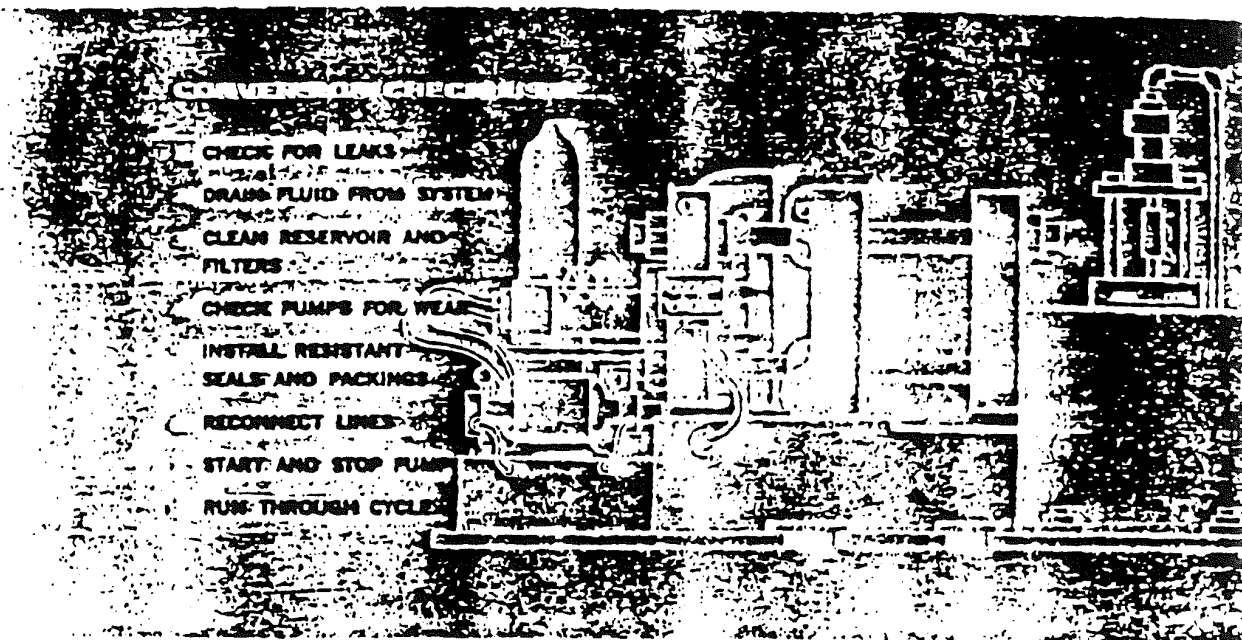
RUN THROUGH CYCLE

Run through the cycle several times to use all parts of the hydraulic system. Bleed any air through the petcocks or valves from parts that might collect air. Check the fluid level and add Pydraul if necessary.

NVF 003505

You can keep fluid make-up at a minimum with adequate maintenance

The normal loss of Pydraul in a properly converted system will be no more than for petroleum fluids, and in many cases, it has been considerably less. The technique for holding down the make-up requirement for Pydraul is the same as for any fluid; namely, regular maintenance checks for loose joints. Losses of Pydraul in diecasting machines are generally as low as one pint per eight-hour shift. If you reclaim leakage, your losses can be cut even further. It is not unusual to find the annual cost of hydraulic fluid actually *decreases* after Pydraul has been installed.



Packing and seal information

Availability of packings and seals for Pydraul fluids is no problem—manufacturers supply them in all configurations. Resistant materials are generally required only for dynamic (moving) seals. Static seals may be ordered in resistant materials if the user prefers. The chart at right lists the manufacturers who supply packings and seals resistant to Pydraul. The list is intended as a guide, and the equipment manufacturer or packing supplier should be contacted for latest recommendations.

NVF 003506

SUPPLIER	TYPE OF MATERIAL	"O" Rings	"V" Rings	"U" Packings	Flat Gaskets	Oil Seals	Back-up Rings	"U" Cups	Flange Packings	Other
A. W. Chesterton Co. Everett, Mass.	Butyl—Fabric	X	X							
Acushnet Process Co. New Bedford, Mass.	Silicone Butyl Viton	X X X		X X X	X X X					X X X
Anchor Packing Co. 401 N. Broad St. Philadelphia, Pa.	Silicone Teflon Impregnated duck Impregnated asbestos Butyl	X X X X X	X X X X X	X X X X X	X X X X X	X X X X X	X X X X X	X X X X X	X X X X X	X X X X X
C. W. Marsh Co. Muskegon, Mich.	Impregnated leather	X	X	X	X	X	X	X	X	X
Chicago Rawhide Mfg. Co. 1301 Elston Ave. Chicago 22, Ill.	Butyl Silicone Viton Teflon	X X X X	X X X X	X X X X	X X X X					X X X X
Crane Packing Co. 1800 Cuyler Ave. Chicago 13, Ill.	Silicone Butyl	X X	X X		X X		X X	X X	X X	X X
Garlock Packing Co. Palmyra, New York	Silicone Butyl Teflon Viton Leather Asbestos Butyl impregnated duck	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X X
Greene, Tweed & Co. North Wales, Pa.	Asbestos Butyl Impregnated duck Phenolic Teflon	X X X X X	X X X X X	X X X X X	X X X X X		X X X X X	X X X X X	X X X X X	X X X X X
Goshen Rubber Co., Inc. P.O. Box 416 Goshen, Indiana	Butyl Silicone	X X		X X	X X		X X	X X	X X	X X
International Packings Corp. Bristol, New Hampshire	Silicone Butyl Viton Leather	X X X X	X X X X	X X X X	X X X X			X X X X	X X X X	X X X X
Linear, Inc. State Road & Levick St. Philadelphia, Pa.	Butyl Vyram Vyram—Fabric	X X X	X X X				X X X			
Plastic & Rubber Products Co. 2100 Hyde Park Blvd. Los Angeles, Calif.	Butyl Silicone	X X								X X
Precision Rubber Products Corp. 3100 Oakridge Drive Dayton 7, Ohio	Butyl	X								
Raybestos-Manhattan, Inc. Packing Div. Passaic, New Jersey	Asbestos Teflon Butyl—Duck Butyl—Asbestos Asbestos—Teflon		X X X X X	X X X X X				X X X X X	X X X X X	X X X X X
Vellumoid Co. Rockdale St. & Beaman Ave. Worcester 6, Mass.	Vellumoid				X					X
W. S. Shamban Co. 11617 W. Jefferson Blvd. Culver City, Calif.	Teflon Nylon KEL F	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X

CONTACT THE MATERIAL SUPPLIER FOR HIS LATEST RECOMMENDATIONS

NVF 003507

Other hydraulic components... readily available

FILTERS Most standard oil filters are satisfactory and you can use active earth or clay types. Manufacturers supplying filters include:

Briggs Filtration Company	Hilliard Corporation
Capital Engineering Company	Honan-Crane Corporation
Cuno Engineering Corporation	Marvel Engineering Company
Dollinger Corporation	Fulfillo
Purostat	Mayhew

HOSE Although both neoprene and Buna N swell somewhat in Pydraul, they have given satisfactory life with the fluid when made of reinforced wire braid construction. Butyl hoses are resistant and are preferred when new hoses are installed. Suppliers of butyl hose include:

Aeroquip Corporation	Electric Hose & Rubber Company
Anchor Coupling Company	Resistoflex Corporation
Eastman Manufacturing Company	Weatherhead Corporation

SWIVEL COUPLINGS Pydraul is being used in systems containing swivel couplings supplied by such companies as:

Berco Manufacturing Company	Chickson Company
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PIPE JOINTS can be obtained from:

Crane Packing Company (John Crane Plastic Lead Seal No. 2)
General Electric Company (Glyptal 1201 Red Enamel)
Permatex Company (Permatex Special Sealant No. 1282)
Dow Corning Corporation (Silastic 6127 putty)
Shell Chemical Company (Epon Adhesive VI)
Friesland Plastics Company (Teflon Tape Seal)

BLADDERS Many hydraulic systems contain a bladder to separate the fluid from air pressure or nitrogen. For these, butyl rubber is necessary. Suppliers include:

Grease Hydraulics Incorporated	Superior Pipe Specialties Company
Hydramotive Incorporated	

PAINTS resistant to Pydraul are supplied by:

Amecost Corporation (South Gate, California)
Andrew Brown Paint Company (Los Angeles, California)
Carboline Company (St. Louis, Missouri)
Correl Products (Farmingdale, New York)
Corrosion Chemical Company of America (Beverly Hills, California)
Finch Paint & Chemical Company (Torrance, California)
W. P. Fuller & Company (Los Angeles, California)
General Paint Company (San Francisco, California)
The Glidden Company (Chicago, Illinois)
Industrial Finishes Company (Philadelphia, Pennsylvania)
Interchemical Corporation (Los Angeles, California)
Lowe Brothers Company (Dayton, Ohio)
Magna Coatings Corporation (Los Angeles, California)
Minnesota Platon Corporation (Pipestone, Minnesota)
Nycote Laboratories (Van Nuys, California)
Pacific Paint & Varnish Company (Berkeley, California)
Parker Paint Company (Tacoma, Washington)
Pittsburgh Plate Glass Company (Milwaukee, Wisconsin)
Power Paint Company (Compton, California)
Rinshed Mason Company (Anaheim, California)
Royalty Paint & Varnish Company (Pasadena, California)
Saran Protective Coatings Company (Ferndale, Michigan)
Sherwin-Williams Company (Chicago, Illinois)
Sinclair Refining Company (New York, New York)
Titanine, Incorporated (Union, New Jersey)
Warren Company (Atlanta, Georgia)

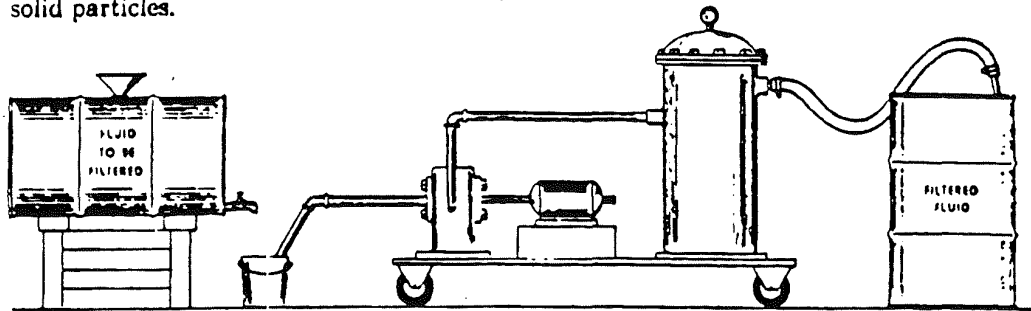
CONTACT THE SUPPLIER FOR LATEST RECOMMENDATIONS

NVF 003508

To reclaim Pydraul, follow these simple instructions

(You can actually reclaim Pydraul lost from leaks and spills because of its exceptional stability and resistance to water. If fluid losses are appreciable—such as in mining equipment that seems to leak despite careful maintenance—recovery of fluid can result in considerable savings. Simply placing a container beneath leaks until they can be repaired will save some fluid. Where drip pans have been used beneath hydraulic machinery, more than half of the Pydraul purchased has been reclaimed. Savings like these reduce overall fluid costs and help make Pydraul the most economical straight synthetic fire-resistant fluid available.)

Reclaiming Pydraul consists of two steps: removing water, and filtering dirt or other solid particles.



FLUID PURIFICATION SYSTEM

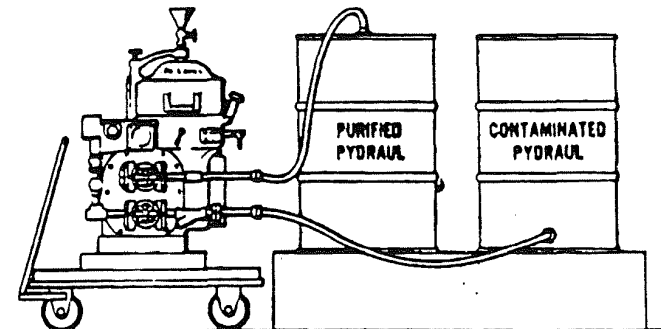
TO SEPARATE WATER

Water does not mix with Pydraul and will form a layer on top of the Pydraul. In the shop, a drum can be reserved for collecting contaminated fluid. A drum with a side and end bung placed horizontally on a cradle about two feet above the floor is a simple and effective settling chamber. Salvaged fluid can be added through a large funnel left in the top opening and drained periodically as the water separates (see diagram). More elaborate systems might use settling tanks, sight gauges and so on.

A second method employs a centrifuge. Suitable units are made by De Laval and Sharples Co. Centrifuges have the advantage of separating water from large volumes of fluid in a short time.

TO FILTER OUT SOLID PARTICLES

A number of filtration units are available in complete units with filter, pump and motor. Hilliard, Cune and Menon-Crane are among the suppliers. Other systems use filter media such as cotton linters, felt, or metal screens. Allapugus clay, diatomaceous earth and Fuller's earth may be used to help keep the fluid clean, dry, low in neutralization number and light in color. A small pump and motor can be used to pump the Pydraul through the filter, and into a clean storage drum.



CENTRIFUGE SYSTEM FOR PURIFICATION

NVF 003509

Safe handling information

Animal toxicity studies and human experience indicate that the Pydraul fluids may be used safely if a few reasonable precautions are taken. Repeated or prolonged skin contact should be avoided since the fluids are excellent solvents for the oils normally components of the skin. When splashed or sprayed into the eyes, the Pydraul fluids cause painful smarting. There is no evidence, however, of any permanent eye injury. In the event of accidental contact with the eyes, the eyes should be flushed with copious amounts of water for 15 minutes and the workman referred to a physician; physicians have used 1% pontocaine solution and ophthalmic cortisone acetate solution to relieve irritation.

Respiratory protection or mechanical exhaust ventilation should be provided if there is repeated and prolonged contact of the fluid with heated surfaces with resulting volatilization or possible decomposition of the fluid. For short periods, such as might arise in turning off equipment following the rupture of a hydraulic line or other mechanical failure, no such protection is necessary.

Toxicity studies demonstrate that the Pydraul fluids are comparable, generally, to petroleum-based hydraulic fluids with respect to short-term massive exposures. The details of animal toxicity studies are available from Monsanto's Medical Department.

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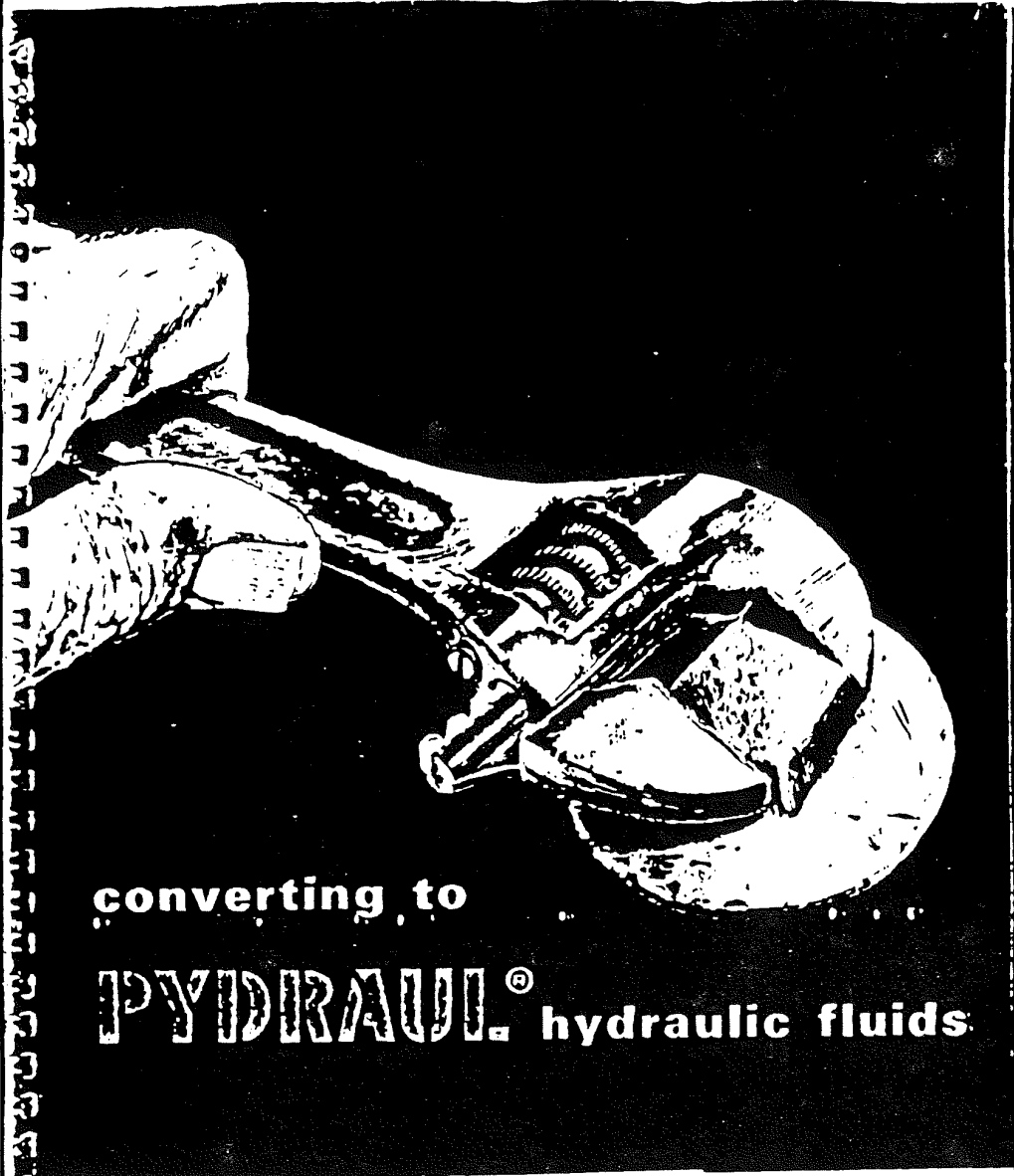


ST. LOUIS, MO. 63166

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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.

NVF 003510



converting to

PYDRAUL® hydraulic fluids



NVF 003511



CONVERTING TO PYDRAUL® is easy

You can convert to Pydraul hydraulic fluids, which are straight synthetics, no matter what type of hydraulic fluid you use now. Equipment manufacturers have had a great deal of experience in converting nearly every type of hydraulic equipment that needs a fire-resistant fluid to a Pydraul fluid. We suggest you contact your equipment manufacturer for conversion recommendations. Many independent machine builders will, under contract, complete the conversion for you.

NVF 003512

For machines now running on a straight synthetic with Viton® or Silicone seals, Pydraul A-200 or Pydraul 625 can be added as make-up without interrupting your production.

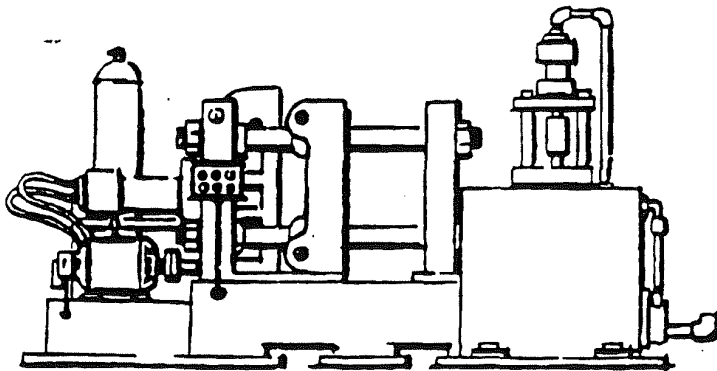
If you are using oil or water-based fluids, there are several very simple conversion steps. Basically, you must drain and clean your system, change your dynamic seals to seals compatible with Pydraul hydraulic fluid and then add Pydraul.

It will generally take two men, an eight-hour shift to convert one hydraulic system. This estimate allows ample time to do the job right, the first time, and prevent costly down-time in the future.

The following procedures should carry you simply and smoothly through your conversion, but our technical specialists for Pydraul fluids are always ready to help make your job easier... contact your local Monsanto Sales and Service Office.

conversion procedure . . .

- | | |
|--------------------------------|---|
| 1. CHECK FOR LEAKS | 3. INSTALL RESISTANT SEALS AND PACKINGS |
| 2. DRAIN FLUID FROM SYSTEM | 6. RECONNECT LINES |
| 3. CLEAN RESERVOIR AND FILTERS | 7. START AND STOP PUMP |
| 4. CHECK PUMPS FOR WEAR | 8. RUN THROUGH CYCLE |



*Viton is a trademark of Du Pont Co.

NVF 003513

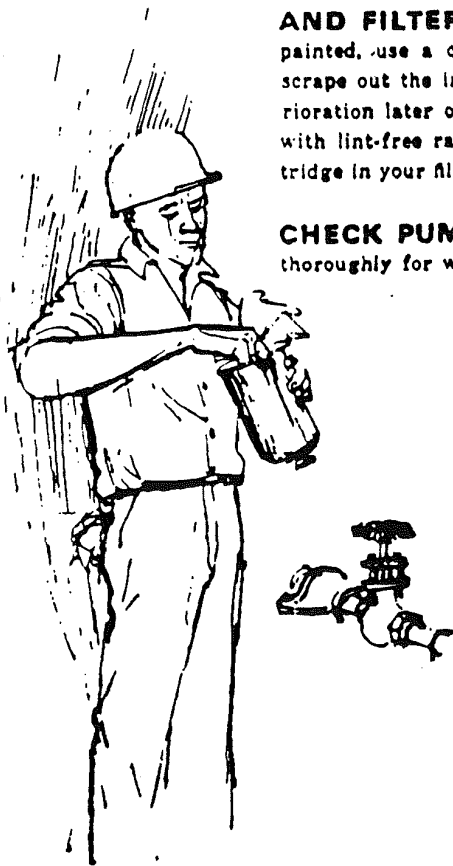
STEPS FOR

CHECK FOR LEAKS — Check your entire system for leaks before you shut down. Mark any leaks for sealing after the system is drained.

DRAIN THE SYSTEM — Drain your present fluid as completely as possible from reservoir, lines and cylinders. Flush system with steam or warm water to avoid residual oil and water-glycol sludge that can reduce Pydraul fluid fire-resistance. You may also be able to do this by opening unions at low spots in your system and blowing out with clean dry air. Seal any leaks.

CLEAN RESERVOIR AND FILTERS — If your reservoir is painted, use a commercial paint remover or scrape out the interior to prevent paint deterioration later on. Wipe your reservoir clean with lint-free rags. Clean or change the cartridge in your filter.

CHECK PUMPS — Check your pumps thoroughly for wear. Replace any worn parts.



NVF 003514

CONVERSION

CHANGE SEALS, PACKINGS AND HOSES

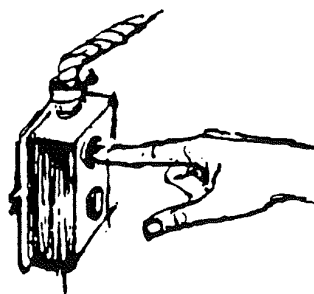
— Change your dynamic seals to seals compatible with Pydraul hydraulic fluid. If you use reinforced type hoses that are in good condition, you normally won't need to change them. If your hoses undergo severe flexing, we recommend butyl or Teflon-lined hoses. Your accumulator diaphragms should be of butyl, Viton, EPR or silicone. Avoid buna elastomers, neoprene and natural rubber.



RECONNECT LINES — Reconnect your lines, and tighten firmly. Fill your system with Pydraul to the manufacturer's recommended level.

START AND STOP PUMP—With the hydraulic controls in neutral, start and stop your pump several times, without allowing the system to reach working pressure. This procedure will lubricate the pump. Then you can leave the pump on to bring the system up to working pressure.

RUN THROUGH CYCLE—Run through the full operating cycle several times to use all parts of your system. Bleed any trapped air through the petcocks. Check your fluid level and add Pydraul if necessary.



Now you're ready to operate...

CONVERSION
CHECK LIST
SEALS
& PACKINGS
FILTERS
& HOSES
OTHER
COMPONENTS
RECLAIMING
PYDRAUL
& STORAGE

NVF 003515

SEALS AND PACKINGS INFORMATION

Materials compatible with Pydraul hydraulic fluid are necessary for dynamic or moving seals. For static seals they are preferred, but not essential. The following table indicates which materials we recommend, depending on the Pydraul fluid you choose.

PYDRAUL FLUID	BUTYL	EPR	VITON	SILICONE	BUNA N	NEOPRENE	NATURAL RUBBER
A-200	M	M	R	R	U	U	U
F-9	S	S	R	R	U	U	U
150	R	R	S	R	U	U	U
625	S	S	R	R	U	U	U
AC	S	S	R	R	U	U	U
60	R	R	U	S	U	U	U
312	M	M	R	R	U	U	U

R — Recommended S — Satisfactory M — Marginal U — Unsatisfactory

This chart of component manufacturers is a guide to obtaining seals completely compatible with Pydraul fluids. You can contact your equipment manufacturer or seal supplier for their most current recommendations.

NVF 003516

TYPE OF MATERIAL OR TRADEMARKED PRODUCT

Supplier		Type of Material	SEALS & PACKINGS			FILTERS & HOSES			OTHER COMPONENTS			RECLAIMING PYDRAUL			HANDLING & STORAGE		
			Oil Resistant	Water Resistant	Acid Resistant	Oil Resistant	Water Resistant	Acid Resistant	Oil Resistant	Water Resistant	Acid Resistant	Oil Resistant	Water Resistant	Acid Resistant	Oil Resistant	Water Resistant	Acid Resistant
A. W. Claiborne Co. Lowell, Mass.	Burlap Fabric																
Reichardt Products Co. Pawtucket, Mass.	Silicone Butyl Viton, Fluorol Ethylene Propylene Rubber (EPR) (Copolymer & Terpolymers)																
American Packing Co. 401 N. Broad Street Philadelphia, Pa.	Silicone Teflon Impregnated cloth Impregnated asbestos Butyl Viton																
Bennings, Inc. 1631 E. 14th Ave. Cleveland 15, Ohio	Butyl Silicone Teflon Viton Leather Butyl Impregnated EPR																
C. W. Marsh Co. Madison, Wis.	Impregnated leather																
Chicago Rubber Mfg. Co. 1111 E. 14th Ave. Chicago, Illinois	Butyl Silicone Viton Teflon Fluorol																
Greene Packing Co. 6400 E. 14th St. Morton Grove, Ill.	Silicone Butyl Teflon Viton A-100																
Carlin & Packing Co. Palmyra, New York	Silicone Butyl Teflon Viton Leather Asbestos Nylon																

Reichardt Products Co.
Pawtucket, Mass.

Reorganized to combine
 Wheel - Moment, Moring & Manufacturing Co
 to form - Dupont Co.

NVF 003517

TYPE OF MATERIAL OR TRADEMARKED PRODUCT

Supplier	Type of Material	Q-100	Q-101	Q-102	Q-103	Q-104	Q-105	Q-106	Q-107	Q-108	Q-109	Q-110
Cordier Rubber Co., Inc. P. O. Box 416 Cordier, Indiana	Butyl Silicone	x	x	x	x	x	x	x	x	x	x	x
International Packings Corp. Bristol, N.H.	Silicone Butyl Viton Leather	x	x	x	x	x	x	x	x	x	x	x
Emery, Inc. State Road & Leuch St. Philadelphia, Pa.	Butyl	x	x	x	x	x	x	x	x	x	x	x
Parker Seal 1067 Jefferson Blvd Culver City, Calif.	Viton Ethylene Propylene Silicone	x	x	x	x	x	x	x	x	x	x	x
Plastic & Rubber Prod. Co. 2100 Hyde Park Blvd. Los Angeles, Calif.	Butyl Silicone	x	x	x	x	x	x	x	x	x	x	x
Precision Rubber Prod. Corp. 3100 Oakridge Drive Dayton, Ohio	Butyl Silicone Viton EPR & EPDM	x	x	x	x	x	x	x	x	x	x	x
Raybestos Manhattan, Inc. Packaging Div. Passaic, New Jersey	Asbestos Teflon Butyl Duck Butyl Asbestos Asbestos Teflon Silicone Silicone Asbestos Viton, Viton Asbestos	x	x	x	x	x	x	x	x	x	x	x
Reliable Rubber Prods. Lakewood, Pa.	All Types of Elastomers	x	x	x	x	x	x	x	x	x	x	x
Vetco-Metall Co. One Lake St. & Main Ave. Worcester 6, Mass.	Vetco-Metall*	x	x	x	x	x	x	x	x	x	x	x
W. S. Shuman Co. 1167 W. Jefferson Blvd. Culver City, Calif.	Teflon Nylon KCI F*	x	x	x	x	x	x	x	x	x	x	x

*Designated trademarks
Vetco-Metall - Vetco-Metall Co.
KCI F - W. W. Kellogg Co.

NVF 003518

FILTERS AND HOSES

FILTERS

Most standard oil filters are satisfactory.
You can use active earth or clay types.
Filter manufacturers include:

Briggs Filtration Division
Bowser Corporation
Cookeville, Tennessee

Capital Engineering Company
5839 S. Ashland Avenue
Chicago, Illinois

Commercial Filters Corporation
(Honen-Crane)
Lebanon, Indiana

Cuno Engineering Corporation
Sub. of American Machine
& Foundry
4627 S. Vine Street
Meriden, Connecticut

Dollinger Corporation
20 Centre Park
Rochester 3, New York

Fulflo Specialties Company, Inc.
410 Fancy Avenue
Blanchester, Ohio

Hilliard Corporation
98 W. Fourth Street
Elmira, New York

Marvel Engineering Company
7227 North Hamlin Avenue
Chicago 45, Illinois

Mayhew Products Company
5043 S. Santa Fe Avenue
Los Angeles, California

Pall Corporation
32 See Cliff Avenue
Glen Cove, L. I., New York

Purulator Products
1000 New Brunswick Avenue
Rahway, New Jersey

Rosaen Filter Corporation
1776 E. Nine Mile Road
Hazel Park, Michigan

Schroeder Bros. Corporation
101 Nichol Avenue
McKees Rocks, Pennsylvania

Service Filtration Corporation
3443 W. Chicago Avenue
Chicago 51, Illinois

HOSES

Although both neoprene and Buna elastomers swell somewhat in Pydraul, hose of these materials have given satisfactory service when made of a reinforced braid construction. Butyl or Teflon lines are preferred when new hoses are installed.
Suppliers include:

Aeroquip Corporation
300 S. East Avenue
Jackson, Michigan

Anchor Coupling Company
360 N. Fourth Street
Libertyville, Illinois

Eastman Manufacturing Company
(See Imperial-Eastman Corporation)
Department T. R.
6300 W. Howard Street
Chicago 48, Illinois

Electric Hose & Rubber Company
1201 Duro Street
Wilmington, Delaware

Resistoflex Corporation
Roseland, New Jersey

Stratoflex, Inc.
222 Roberts Cutoff Road
Fort Worth, Texas

Weatherhead Corporation
302 E. 131st Street
Cleveland, Ohio 44108

FILTERS
& HOSES

OTHER
COMPONENTS

RECLAIMING
PYDRAUL

HANDLING
& STORAGE

NVF 003519

OTHER

SWIVEL COUPLINGS

Systems for Pydraul Fluids often contain swivel couplings. Some suppliers are:

Barco Manufacturing Company
(See Aeroquip — Barco Division)
540 Hough Street
Barrington, Illinois

Chiksan Division
FMC Corporation
332 N. Brea Boulevard
Brea, California

PIPE JOINT SEALERS

... can be bought from:

American Sealants Company
(See Loctite Corporation)
115 No. Mountain Road
Hartford 11, Connecticut

Crane Packing Company
6410 Oakton Street
Morton Grove, Illinois

Dow Corning Corporation
Midland, Michigan

Friesland Plastics Company
Friesland, Wisconsin

General Electric Company
Insulating Materials Department
1 Campbell Road
Schenectady 6, New York

Permatex Company
Department T. R.
Flagler Court Building
West Palm Beach, Florida

W. S. Shamban & Company
11617 W. Jefferson Boulevard
Culver City, California

Shell Chemical Company
110 West 51st Street
New York, New York

ACCUMULATORS

... many hydraulic systems for Pydraul contain an accumulator which uses a bladder to separate the fluid from air or nitrogen pressure. For these, a rubber compatible with the fluid is necessary. Suppliers include:

Greer Hydraulics, Inc.
5930 W. Jefferson Boulevard
Los Angeles, California

Superior Pipe Specialties Company
Box 191
Cicero, Illinois 60630

NVF 003520

COMPONENTS

PAINTS

... resistant to Pydraul are supplied by:

Amercoat Corporation
Department T
Brea, California

Andrew Brown Paint Company
5413 S. District Boulevard
Los Angeles, California

Carboline Company
32-R Hanley Industrial Court
St. Louis, Missouri

Carrol Products
148 Marine Street
Farmingdale, New York

Finch Paint & Chemical Company
Torrance, California

W. P. Fuller & Company
1645 W. Valencia Drive
Fullerton, California

The Glidden Company
900 Union Commerce Building
Cleveland, Ohio

Interchemical Corporation
Finishes Division
1255-T Broad Street
Clifton, New Jersey

Lowe Brothers Company
Third & Madison Streets
Dayton, Ohio

Magna Coatings & Chemical
Corporation
1785 N. Eastern Avenue
Los Angeles, California

Nycote Laboratories
15002 Delano Street
Van Nuys, California

Pittsburgh Plate Glass Company
One Gateway Center
Pittsburgh 22, Pennsylvania

Rinshed-Mason Company
5935 Milford
Detroit, Michigan

Royalty Paint & Varnish Company
Pasadena, California

Saran Protective Coatings Company
2415 Burdette at Reed
Ferndale, Michigan

Sherwin-Williams Company
101 Prospect Avenue, N. W.
Cleveland, Ohio

Titanine, Inc.
Seagrave Corporation
Elmwood & Morris Avenues
Union, New Jersey

U. S. Paint, Lacquer &
Chemical Company
2101 Singleton
St. Louis, Missouri



OTHER
COMPONENTS

RECLAIMING
PYDRAUL

HANDLING
& STORAGE

NVF 003521

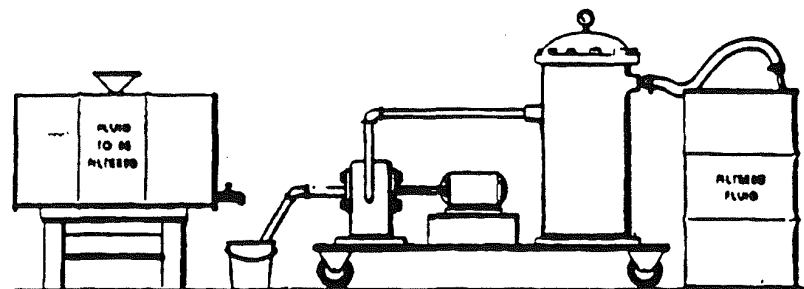
RECLAIMING

You can actually reclaim Pydraul hydraulic fluid lost from leaks and spills because it is exceptionally stable and resistant to water and other contaminants. If your fluid losses are appreciable — such as in mining equipment that seems to leak despite careful maintenance — fluid recovery can result in considerable savings. Simply placing a container beneath leaks until they can be repaired will save some fluid. Where drip pans have been used beneath hydraulic machinery, more than half of the total Pydraul leakage has been reclaimed.

This dollar-saving recovery appears especially advantageous because it isn't practical to reclaim either water glycol or water-oil emulsions except to filter out large dirt particles. Reclaiming Pydraul fluid helps make it the most economical fire-resistant fluid available.

Reclaiming Pydraul consists of two steps: removing water, and filtering dirt or other solid particles.

TO SEPARATE WATER . . . Water does not mix with Pydraul and will, therefore, form a layer on top. A drum reserved for contaminated fluid with a side and end bung, placed horizontally on a cradle about two feet off the floor, is a simple and effective settling chamber. You can add salvaged fluid through a large funnel in the top opening and periodically drain off the Pydraul through the lower opening. For a more elaborate system, you might use



FLUID PURIFICATION SYSTEM

NVF 003522

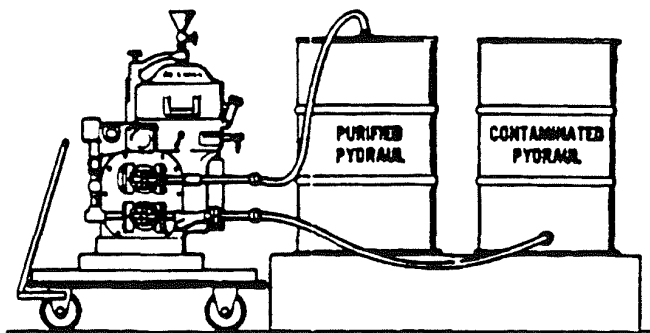
PYDRAUL FLUIDS

settling tanks, sight gauges or a commercial installation.

A second method is centrifuging. Suitable units are made by DeLaval and Sharples Co. Centrifuges operate swiftly, . . . will separate water from large volumes of fluid in a short time.

TO FILTER OUT SOLID PARTICLES

. . . A number of filtration units are available complete with filter, pump and motor. Other systems use filter media like cotton linters, felt, or metal screens. Attapulgis clay, diatomaceous earth and Fuller's earth may be used to help keep the fluid clean, dry, low in neutralization number and light in color. Use a small pump and motor to pump the Pydraul through the filter, and into a clean storage drum.



CENTRIFUGE SYSTEM FOR PURIFICATION

RECLAIMING
PYDRAUL

HANDLING
& STORAGE

NVF 003523

H A N D L I N G

Animal toxicity studies and human experience indicate that the Pydraul hydraulic fluids may be used safely if a few reasonable precautions are taken. Repeated or prolonged skin contact should be avoided not only to prevent absorption of the material and possible systemic effect but, also, because the fluids are excellent solvents for the oils normally present in the skin. Thus, drying and irritation could occur.

When splashed or sprayed into the eyes, Pydraul causes painful smarting. There is no evidence, however, of any permanent eye injury. In the event of accidental contact with the eyes, the eyes should be flushed with copious amounts of water for 15 minutes and the workman referred to a physician; physicians have used 1% Pontocaine solution and ophthalmic cortisone acetate solution to relieve irritation.

When Pydraul is kept at room temperature, it does not constitute a vapor inhalation hazard except in a confined, unventilated space. Respiratory protection or mechanical exhaust ventilation should be provided if there is repeated and prolonged contact of the fluid with heated surfaces with resulting volatilization or possible decomposition of the fluid. Where a ruptured oil hydraulic line near a white-hot surface means a fire, a ruptured hydraulic line containing Pydraul causes a vapor with an unpleasant odor that can help you locate the trouble. For short periods, such as turning off equipment following the rupture of a hydraulic line or other mechanical failure, no protection is necessary.

NVF 003524

STORAGE

Pydraul hydraulic fluids can be stored at sub-zero temperatures without damaging them. Simply allow the Pydraul to warm to room temperature before you use it. If drums of Pydraul must be stored outside, seal them tightly and lay them on their side to keep out moisture.



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HANDLING
& STORAGE

NVF 003525

SALES & SERVICE OFFICES

ATLANTA, GEORGIA 30326
Lenox Towers West,
3190 Peachtree Rd. N.E.
Tel. (404) 231-4320

BOSTON, MASSACHUSETTS 02149
Everett Station
Tel. (617) Dunkirk 7 5010

CHICAGO, ILLINOIS
3150 Des Plaines Ave.
Des Plaines, Illinois 60018
Tel. (312) 296 6688

CINCINNATI, OHIO 45206
2330 Victory Parkway
Tel. (513) 751 6707

CLEVELAND, OHIO 44122
3645 Warrensville Center Rd.
Tel. (216) 991 5400

DETROIT, MICHIGAN 48235
500 Northland Towers
Tel. (313) 357 0910

HOUSTON, TEXAS 77002
1300 Main Street
Tel. (713) Capital 3 4011

LOS ANGELES, CALIFORNIA 90022
6670 E. Flamingo St.
Tel. (213) Raymond 3-2492

MINNEAPOLIS, MINNESOTA 55402
912 Northstar Center 110 S. Seventh St.
Tel. (612) Federal 9 4651

NEW YORK, NEW YORK 10017
277 Park Avenue
Tel. (212) 922 4111

PITTSBURGH, PENNSYLVANIA
No. 4 Gateway Center Bldg. Room 1406
Tel. (412) 261 2156

ST. LOUIS, MISSOURI 63166
800 N. Lindbergh Blvd.
Tel. (314) Wydown 3-1000

SAN FRANCISCO BAY AREA
2710 Lafayette, Santa Clara, Calif. 95052
Tel. (408) 243 0414

SEATTLE, WASHINGTON 98104
911 Western Avenue
Tel. (206) Main 2-4203

SPRINGFIELD, MASSACHUSETTS 01102
812 Monsanto Ave.
Tel. (413) 788 6911

WILMINGTON, DELAWARE 19803
2005 Concord Pike, Fairfax
Tel. (302) Olympia 8 6531

FUNCTIONAL
FLUIDS



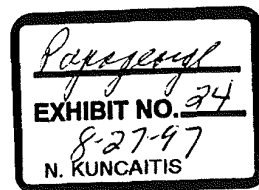
Monsanto Company • 800 N. Lindbergh • St. Louis, Missouri 63166

NVF 003526

MONSANTO
CHEMICALS

AROCLOR
A NONFLAMMABLE HYDRAULIC FLUID FOR
DIE-CASTING SYSTEMS

Monsanto Technical Bulletin No. P-10
March 28, 1949
Monsanto Chemical Company
St. Louis 4, Mo.



Aroclor* 1248, chlorinated biphenyl, the safe and economical organic hydraulic fluid for metal die-casting systems, eliminates the constant threat of serious fire hazard associated with the use of combustible hydraulic fluids in the die-casting industry.

This safe and economical hydraulic fluid has been in continuous satisfactory use in individualized die-casting units for about ten years and in centralized systems for the past two years.

* * * *

*Registered in U. S. Patent Office

The information in this bulletin is based on our experience, represents our best judgment in the matter, and is intended to be helpful but we cannot assume responsibility for any loss or accident that may result from its use.

NVF 003204

I. INTRODUCTION

Aroclor 1248, chlorinated biphenyl, the safe and economical organic hydraulic fluid for metal die-casting systems, eliminates the constant threat of serious fire hazard associated with the use of combustible hydraulic fluids in the die-casting industry.

There are not many available noncombustible organic fluids and only very few possess the over-all physical requirements of hydraulic fluids for die-casting systems. Notwithstanding the possibility of sustaining costly fire damage when using relatively inexpensive petroleum oils, the economics involved in replacing petroleum oils with the more expensive noncombustible organic hydraulic fluids is an important factor to the industry. In this connection, it is important to emphasize that Aroclor 1248 appears to be substantially less expensive than the few other available noncombustible organic hydraulic fluids for this purpose.

Aroclor 1248 has been used successfully in die-casting machines for many years and satisfactory continuous service records on Aroclor 1248 extend beyond ten years. It is used throughout the industry as widespread and leading die-casters have installed Aroclor 1248 to replace combustible oils and also to replace other noncombustible organic fluids, because of the demonstrated good performance obtainable with Aroclor 1248 and because of its lower initial cost and lower "make-up" requirements in the system.

II. INDIVIDUALIZED DIE-CASTING SYSTEMS

Aroclor 1248 has been used continuously for many years in individualized die-casting units using machines built by Lester Engineering Company (13), The Hydraulic Press Mfg. Co. (11), H. L. Harvill Mfg. Co. (9), and the Cleveland Automatic Machine Co. (4), as well as excellent "home built" units. Frequently, these machines are equipped with vane type centrifugal pumps such as the ones made by Vickers, Incorporated (21), but other types of centrifugals may also be used.

The Watson-Stillman Company's (22) die-casting machines are used as individualized units equipped with Oilgear piston type pumps made by The Oilgear Company (15). Aroclor 1248 is suggested as a noncombustible hydraulic fluid for installations of this type.

In most instances, the normal operating temperature of the hydraulic fluid is within the range of 80°-120°F. and this temperature may or may not be controlled by jacketed water coolers, depending on the specific design of the die-casting machine. Most of these machines use 60-200 gallons of the hydraulic fluid and operate at pressures ranging as high as 1,000-3,000 p.s.i.

III. CENTRALIZED DIE-CASTING SYSTEMS

Aroclor 1248 has been in continuous satisfactory use for a number of years in centralized die-casting systems consisting of batteries of the machines connected to a central tank of the Aroclor hydraulic fluid. These systems are usually equipped with piston type pumps such as made by The Oilgear Company and have an accumulator in the line to maintain smooth operation. Such centralized systems may operate with 2,000 gallons, or even more, of Aroclor 1248. Systems of this type using Aroclor 1248 and Oilgear pumps have been in continuous service for a number of years with apparently satisfactory performance.

IV. PHYSICAL PROPERTIES OF AROCLOR 1248

The physical properties of Aroclor 1248 are listed below with similar constants for Aroclor 1254. The reason for including Aroclor 1254 is that in some instances, especially for viscosity considerations, it may be desirable to blend small portions of Aroclor 1254 with Aroclor 1248. For more complete data about the low vapor pressure of Aroclors, their low vaporization rates, their viscosity ranges, their noncorrosive properties, high order of stability to heat and corrosive influences, as well as other pertinent qualities, please refer to Monsanto Technical Bulletin No. P-115 entitled, "The Aroclors" (14 bibliography reference).

TABLE I. Outline of Physical Properties

	<u>Aroclor 1248</u>	<u>Aroclor 1254</u>
Form	Yellow tinted mobile oil	Light yellow viscous oil
Color--APHA	100 Max.	100 Max.
Acidity--Maximum (mgm. KOH/Gm.)	0.015	0.015
Average Coefficient of Expansion - cc/cc/°C.	0.00070 (25°-65°C.)	0.00066 (25°-65°C.)
Density--		
Specific Gravity 25°/25°C. (77°/77°F.)	1.447 to 1.457	1.538 to 1.548
Pounds per Gallon 25°C. (77°F.)	12.08	12.83

TABLE I. (continued)

	<u>Aroclor 1248</u>	<u>Aroclor 1254</u>
Distillation Range--ASTM D-20 (Mod.) Corr. °C.	340°-375°	365°-390°
Vaporization Rate gms/cm hr/100°C.	0.000152	0.000053
Flash Point--Cleveland Open Cup °C.	193°-196°	None
	°F. 379°-384°	
Fire Point--Cleveland Open Cup °C.	None	None
Pour Point--ASTM D-97 °C.	-7°	10°
	°F. 19.4°	50°
Viscosity--Saybolt Universal Sec. (ASTM D-88)		
210°F. (98.9°C.)	36-37	44-48
130°F. (54.4°C.)	69-78	260-340
100°F. (37.8°C.)	185-240	1800-2500
Absolute Viscosity--Centipoises		
212°F. (100°C.)	4.2	8.5
122°F. (50°C.)	25	146
77°F. (25°C.)	208	777

V. NONCOMBUSTIBLE QUALITIES OF AROCLOR 1248

FLASH POINT. Limitations of this test for the prediction of the fire hazard of relatively nonvolatile organic fluids have been recognized by the ASTM committee (1).

FIRE POINT is a more significant measurement. The National Board of Fire Underwriters Laboratories (20) concur 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. (1,299°F.) determined by Sullivan, Wolfe and Zisman (19), using the convenient apparatus described by Sortman, Beatty and Heron (18).

Under industrial use conditions 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. In this connection, we wish to refer to an

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SPRAY FLAMMABILITY. When a line ruptures in a die-casting system where the hydraulic fluid is under relatively high pressure, a spray or mist prevails. The possible fire hazard of Aroclor 1248 under these conditions requires considerations not covered by the foregoing discussion relative to the material in the liquid form. In their comprehensive study, "Flammability of Higher Boiling Liquids and Their Mists", Sullivan Wolfe and Zisman 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 fluid conducted at the Naval Proving Ground, Dahlgren, Virginia. The per cent oxygen requirement for Aroclor 1248 combustion in the spray flammability limit studies was established at 64%. It was observed that fluids requiring over 45-50% of oxygen in the spray test failed to cause a fire in the incendiary test. These results firmly establish the nonflammable and noncombustible qualities of Aroclor 1248. Moreover, these results on spray flammability studies seem most pertinent since they reflect conditions prevailing in the case of pressurized systems such as used in metal die-casting. Therefore, we are taking the liberty of presenting the data in the following Table II as taken from the publication by Sullivan, Wolfe and Zisman to compare this highly significant spray flammability rating given to selected chlorinated hydrocarbons, organic phosphates, etc. Benzene and a petroleum oil are included for comparison purposes.

TABLE II. Flammability of Certain Higher Boiling
Liquids and Their Mists

<u>Fluid</u>	<u>Viscosity</u> <u>Cs. at</u> <u>100°F.</u>	<u>Flash Pt.</u> <u>(COC) (1)</u> <u>°F.</u>	<u>Fire Pt.</u> <u>(COC) (1)</u> <u>°F.</u>	<u>S.I.T.(2)</u> <u>°F.</u>	<u>Spray</u> <u>Flamma-</u> <u>bility</u> <u>Limit %</u> <u>Oxygen</u>
Naval Ordnance hydraulic oil O.S. 1113	41.8	315	340	505	14
Benzene	0.58	12	-	1295	12
Chlorobenzene	0.59	90	-	-	14
o-Dichlorobenzene	0.84	165	-	-	29
1,2,4-Trichlorobenzene	1.1	260	None	>1000	44
Trichlorodiphenyl (Aroclor 1242)	17.7	350	633	1230	45
AROCLOR 1248 (Tetra- chlorodiphenyl)	45.4	380	None	1300	64
Diphenyl ether	2.6	265	275	-	11
Chlorodiphenyl ether	3.0	260	335	-	27
Dichlorodiphenyl ether	4.9	300	465	-	33
Trichlorodiphenyl ether	8.7	325	4901	-	42
Trimethyl phosphate	-	225	245	903	47
Tributyl phosphate	2.6	285	370	-	27
Trioctyl phosphate	8.1	380	465	680	13
Tricresyl phosphate	29	500	685	1170	19
Hexamethyl tetra- phosphate	38.3	>510	None	920	31
Tetrabutyl pyro- phosphate	8.9	465	720	845	14
Dioctylphenyl phosphonate	11.5	435	480	630	21
Diphenyl mono (p-tert- butyl phenyl) phos- phate	40.3	465	720	1076	12
Di-(o-chlorophenyl) monophenyl phosphate	34.3	510	>760	1296	21

- (1) Cleveland Open Cup
(2) Spontaneous ignition temperature

In light of the importance of spray flammability as demonstrated to be the most significant determination of the noncombustible qualities of higher boiling fluids and their mists, it is indeed interesting to note the lack of correlation between this value and other constants, such as,

flash point, fire point and especially the spontaneous ignition temperature.

VI. RESISTANCE OF STRUCTURAL MATERIALS TO AROCLOR 1248

The noncorrosive qualities of Aroclor 1248 and the strong resistance of structural materials to Aroclor 1248 are highly important factors in the practical use of Aroclor as a hydraulic medium in die-casting systems. The following Table III indicates the resistance of structural materials to Aroclors 1248 and 1254.

TABLE III. Resistance of Structural Materials To
Aroclors 1248 and 1254

<u>Metals</u>	<u>1248</u>		<u>1254</u>	
	<u>25°C.</u>	<u>125°C.</u>	<u>25°C.</u>	<u>125°C.</u>
Aluminum	R	R	R	R
Copper	R	D	R	D
Magnesium	RR	R	R	R
Nickel	RR	R	R	RR
Silver	R	R	R	R
Tin	R	R	R	R
Zinc	R	R	R	R
Mild Steel	RR	R	RR	RR
Phosphor Bronze	R	D	R	R
Red Brass	D	D	R	D
Stainless Steel	RR	RR	RR	RR
Yellow Brass	R	Re	R	De

RR--Excellent resistance--less than 1.0×10^6 cm/day penetration or 0.00014 in/yr.

R --Good resistance--has penetration between 1.0×10^6 and 10×10^6 cm/day or between 0.00014 and 0.0014 in/yr.

D --Doubtful resistance--has penetration between 10×10^6 cm/day and 100×10^6 cm/day or between 0.0014 and 0.014 in/yr.

e --Following the letter indicating resistance signifies material may be better than indicated if totally immersed since weight loss is believed to come from oxidation of the part of test strip exposed to air.

VII. PACKING MATERIALS AND GASKETS SUITABLE FOR USE WITH AROCLOR 1248 IN DIE-CASTING SYSTEMS

Results of accelerated laboratory tests show that Hycar P. Koroseal, Perbunan, Neoprene and various other "rubbers" are softened by Aroclors especially at elevated temperatures. Accordingly, questions arise about the use of these materials for gaskets on die-casting machines using Aroclor. However, from practical experience in the operation of die-casting machines, it has been noted that fittings, such as the ball joints made by Chiksan Tool Company (3), containing a small Neoprene gasket have given very good service under long continuous use when installed in die-casting systems operated with Aroclor. Also, Neoprene lined, metalized, flexible tubes used on the return lines of the die-casting machines appear to give good service with Aroclor. In some instances it appears almost necessary to use flexible tubes, especially on the return lines of the die-casting machines. If possible to do so, it would seem desirable to use rigid lines fitted with ball joints such as made by Chiksan or Barco Swivel Joints (2).

For pipe connection, welded joints are not necessary but in the case of welded flange connections, these may be satisfactorily gasketed by the use of a thin sheet of aluminum. Various packing materials suitable for use with Aroclor at elevated temperatures include Garlock Packing Company's (8) #7021, 1/8 inch asbestos fiber sheet for flange connections. Garlock's #117 braided packing is used in valves and Garlock #234 packing is used for pumps; also, Garlock #431 and Chevron 7050-C materials are suitable packings. Likewise, Durametallie (6) spiral asbestos fiber may be used. Doubtless, Johns-Manville Corp. (12) and others have comparable packing materials which would be suitable. In all instances, when ordering packing, it should be indicated to the supplier that the material is intended for use with Aroclor 1248.

Teflon, duPont's (7) polytetrafluoroethylene, is not attacked by hot Aroclor (130°C.) and is to be recommended as a gasket material. Thioko is not attacked by Aroclors at ordinary temperatures and especially Thiokol 1605-A appears of interest for use with Aroclors in die-casting systems. The maximum temperature ranges at which Thiokol is suitable are indicated as follows:

Thiokol Type A - 150°-200°F. max.
Thiokol Type FA - 150°-200°F. max.
Thiokol Type ST - 250°-300°F. max.

Dow Corning's (5) Silastic, Silicone 180 is very resistant to hot Aroclor and use of this material is suggested. The changes in properties of Silicone 180 when immersed in hot Aroclor for 70 hours at 150°C. are summarized as follows:

-
1. Lowering of the hardness by about 20 points.
 2. Improvement in the elasticity by several points.
 3. Practically no change in tensile strength.
 4. An appreciable increase in the ultimate elongation.

Other types of packing materials recommended by the manufacturer for use in Aroclor installations include the following Palmetto (16) packings:

Hydraulic Service (Normal Temperatures)

Rod packing	- Palmetto Pyramid Packing #2510
U Ring packing	- Palmetto U Ring Packing #2610
Flange packing	- Palmetto Flange Packing #2810
Kup packing	- Palmetto Kup Packing #2710
Sheet packing & gaskets	- Palmetto Hi-4 Sheet Packing #2910.

Heat-Transfer Service

Rod packing	- Palmetto High Pressure Packing #2200
Sheet packing & gaskets	- Palmetto Hi-4 Sheet Packing #2910

With reference to the manufacturer and also the user of die-casting equipment, it is highly advantageous if the same packing materials generally used with oil can be used also with Aroclor 1248. In this connection, in the case of The Oilgear Company hydraulic equipment, it is noted that such packings as Thiokol, which is used for gaskets, and Garlock #431, which is used as ram packings on most Oilgear equipment, can be used either with oil or with Aroclor 1248.

Vickers, Incorporated advise that all packing materials will have to be other than those normally used for petroleum base fluids to prevent rapid deterioration, and these are available through Vickers, Incorporated for their own equipment, or many of the suppliers of standard sealing elements.

VIII. LUBRICATION

Aroclor 1248 has lubricating properties and is used in die-casting systems most frequently without the addition of added lubricants. However, in the case of piston type pumps where high lubricity is a requirement, sometimes the practice is to add not more than 5% of a high lubricity oil to the Aroclor. Oils of this type in use are DTE medium heavy high lubricity oil and Pennsylvania Refining Company's (17) #90 VI light stock oil. Other similar oils are available for this purpose

Aroclor 1248 is recognized in the industry as an EP lubricant and its heavy load carrying quality without seizure is reflected by tests made with a hydraulic fluid containing a substantial proportion of Aroclor. The data pertains to results with an Almen test machine. During the standard test, the hydraulic fluid carried the full 30-pound load normally used as maximum on the Almen test. The torque at maximum load passed, average of 2 runs, was found to be 28.5 for the hydraulic fluid built on Aroclor as compared with a value of 14.0 for SAE 10 motor oil.

IX. VISCOSITY

The viscosity of Aroclor 1248 seems to be within the range required in the normal operation of many industrial pumps and hydraulic equipment. As previously indicated, the viscosity of Aroclor 1248 can be increased by the addition of Aroclor 1254. In light of the influence of temperature on the viscosity of Aroclor, this factor should be given consideration with reference to the operation of the pumps or hydraulic system in which Aroclor is used.

As a general indication of the viscosity requirements for different types of pumps, Vickers, Incorporated specifies the following for use with its pumps:

Industrial Machinery Installations (Ambient Temperature 50°F. to 90°F.)

	<u>Type of Installation</u>	<u>Oil Viscosity</u>
Vane Type Pumps	Machine tools operating at pressures up to 1000 p.s.i.	150-225 S.S.U. @ 100°F.
	Presses and other heavy machinery	275-315 S.S.U. @ 100°F.
Piston Type Pumps	All industrial machinery	275-315 S.S.U. @ 100°F.
Piston Type and Gear Type Fluid Motors	All industrial machinery	150-315 S.S.U. @ 100°F.

Vickers recommends that the oil temperatures in the hydraulic circuit should be maintained between 60° and 130°F. If, for reasons of non-operation for extended periods, the temperature drops below 60°F., the fluid should be warmed to that temperature before starting operations.

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Coolers should be provided to prevent temperatures in excess of 130°F., which will comply with the temperatures demanded by the Joint Industry Conference Hydraulic Standards, and should also avoid the necessity of having to use vent ducks from any open or semi-open reservoir.

Referring to the fact that the specific gravity of Aroclor 1248 is greater than the similar value of average petroleum base fluids used, inlet conditions to pumps should be carefully scrutinized to insure the absence of cavitation.

X. FILTRATION

It seems prudent to maintain clean oil regardless of the specific hydraulic fluid used in die-casting systems. Small particles of dirt, metal chips and sand from the castings seem to work their way into the hydraulic fluid whether the installation is a new one or one that has been in service for many years. Aroclor 1248 has a tendency to suspend such impurities. Although it is not always practiced, nevertheless, it seems important to provide adequate filtration so that abrasive particles are removed from the system and the Aroclor 1248 is kept clean.

Many die-casting machines are equipped with internal fine mesh wire screens. These filters are suitable for removing the larger particles, but to keep the Aroclor in a satisfactorily clean condition, the recommendation is to filter the Aroclor through a bed of suitably processed granular Fuller's earth. There are available a number of satisfactory filtering mechanisms or oil purifiers which may be used continuously or intermittently. Probably one of these filters available as a convenient portable model would be the most economical as it could be used to clean the oil in a number of die-casting machines. As one example of a supplier of such equipment, we wish to refer to the Honan-Crane Corporation (10).

XI. DERMATOLOGY AND TOXICOLOGY

Results of standard skin patch tests using over 100 individuals show that Aroclor 1254 is neither a skin irritant nor a skin sensitizer (14). We would expect that these results would serve to indicate that Aroclor 1248, which is only slightly lower in chlorine content than Aroclor 1254, is also neither a skin irritant nor a skin sensitizer.

Although the vapor pressure of Aroclor 1248 is quite low and for all practical purposes the material is nonvolatile, nevertheless, when Aroclors are heated to elevated temperatures, vapors arise and these vapors bear a degree of toxicity and should not be breathed. This

consideration is, of course, minimized in the case of using Aroclor 1248 in die-casting systems, which are necessarily thoroughly enclosed to prevent even the smallest kind of a leak, and the operating temperature is relatively low since practical operation never exceeds about 140°F.

Aroclor 1248 has been used for over ten years in individualized and centralized die-casting systems with complete freedom from any trouble or fear of any toxic effects. If Aroclor 1248 comes in contact with the worker's skin, the skin should be washed in an ordinary manner with soap and water. If the Aroclor is sufficiently hot so as to cause a burn when in contact with the skin, the burn should be treated in the same manner as any ordinary burn. Aroclor adhering to the burned area need not be removed immediately unless treatment of the burn demands it, in which case soap and water or repeated washings with a vegetable oil is recommended.

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MONSANTO CHEMICAL COMPANY
St. Louis 4, Mo.

New York-Chicago-Boston-Birmingham-Charlotte-Cincinnati-Cleveland
Detroit-Philadelphia-Los Angeles-San Francisco-Montreal

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- (4) Cleveland Automatic Machine Co., 4900 Beech Street. Cincinnati 12, Ohio.
- (5) Dow Corning Corp., 592 Saginaw Road, Midland, Michigan.
- (6) Durametallic Corp., 1936 Hall Street, Kalamazoo 24-F. Michigan.
- (7) E. I. duPont de Nemours & Co., Inc., Wilmington 98, Delaware.
- (8) Garlock Packing Company, 250 Main Street, Palmyra, New York.
- (9) H. L. Harvill Mfg. Co., Harvill Building, Corona, California.
- (10) Honan-Crane Corporation, Lebanon, Indiana.
- (11) The Hydraulic Press Mfg. Co., 830 Marion Road, Mount Gilead, Ohio.
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AROCLOR*
A NONFLAMMABLE HYDRAULIC FLUID FOR
DIE-CASTING SYSTEMS

Monsanto Technical Bulletin No. P-137

May 1, 1950

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Monsanto Chemical Company
St. Louis 4, Mo.

Aroclor 1248, chlorinated biphenyl, the safe and economical organic hydraulic fluid for metal die-casting systems, eliminates the constant threat of serious fire hazard associated with the use of combustible hydraulic fluids in the die-casting industry.

This safe and economical hydraulic fluid has been in continuous satisfactory use in individualized die-casting units for about ten years and in centralized systems for the past two years.

* * * *

*Reg.U.S.Pat.Off.

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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.

I. INTRODUCTION

Aroclor 1248, chlorinated biphenyl, the safe and economical organic hydraulic fluid for metal die-casting systems, eliminates the constant threat of serious fire hazard associated with the use of combustible hydraulic fluids in the die-casting industry.

There are not many available noncombustible organic fluids and only very few possess the over-all physical requirements of hydraulic fluids for die-casting systems. Notwithstanding the possibility of sustaining costly fire damage when using relatively inexpensive petroleum oils, the economics involved in replacing petroleum oils with the more expensive noncombustible organic hydraulic fluids is an important factor to the industry. In this connection, it is important to emphasize that Aroclor 1248 appears to be substantially less expensive than the few other available noncombustible organic hydraulic fluids for this purpose.

Aroclor 1248 has been used successfully in die-casting machines for many years and satisfactory continuous service records on Aroclor 1248 extend beyond ten years. It is used throughout the industry as widespread and leading die-casters have installed Aroclor 1248 to replace combustible oils and also to replace other noncombustible organic fluids, because of the demonstrated good performance obtainable with Aroclor 1248 and because of its lower initial cost and lower "make-up" requirements in the system.

II. INDIVIDUALIZED DIE-CASTING SYSTEMS

Aroclor 1248 has been used continuously for many years in individualized die-casting units using machines built by Lester Engineering Company (13), The Hydraulic Press Mfg. Co. (11), H. L. Harvill Mfg. Co. (9), and the Cleveland Automatic Machine Co. (4), as well as excellent "home built" units. Frequently, these machines are equipped with vane type centrifugal pumps such as the ones made by Vickers, Incorporated (21), but other types of centrifugals may also be used.

The Watson-Stillman Company's (22) die-casting machines are used as individualized units equipped with Oilgear piston type pumps made by The Oilgear Company (15). Aroclor 1248 is suggested as a noncombustible hydraulic fluid for installations of this type.

In most instances, the normal operating temperature of the hydraulic fluid is within the range of 80°-120°F. and this temperature may or may not be controlled by jacketed water coolers, depending on the specific design of the die-casting machine. Most of these machines use 60-200 gallons of the hydraulic fluid and operate at pressures ranging as high as 1,000-3,000 p.s.i.

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III. CENTRALIZED DIE-CASTING SYSTEMS

Aroclor 1248 has been in continuous satisfactory use for a number of years in centralized die-casting systems consisting of batteries of the machines connected to a central tank of the Aroclor hydraulic fluid. These systems are usually equipped with piston type pumps such as made by The Oilgear Company and have an accumulator in the line to maintain smooth operation. Such centralized systems may operate with 2,000 gallons, or even more, of Aroclor 1248. Systems of this type using Aroclor 1248 and Oilgear pumps have been in continuous service for a number of years with apparently satisfactory performance.

IV. PHYSICAL PROPERTIES OF AROCLOR 1248

The physical properties of Aroclor 1248 are listed below with similar constants for Aroclor 1254. The reason for including Aroclor 1254 is that in some instances, especially for viscosity considerations, it may be desirable to blend small portions of Aroclor 1254 with Aroclor 1248. For more complete data about the low vapor pressure of Aroclors, their low vaporization rates, their viscosity ranges, their noncorrosive properties, high order of stability to heat and corrosive influences, as well as other pertinent qualities, please refer to Monsanto Technical Bulletin No. P-115 entitled, "The Aroclors" (14 bibliography reference).

TABLE I. Outline of Physical Properties

	<u>Aroclor 1248</u>	<u>Aroclor 1254</u>
Form	Yellow tinted mobile oil	Light yellow viscous oil
Color--APHA	100 Max.	100 Max.
Acidity--Maximum (mgm. KOH/Gm.)	0.015	0.015
Average Coefficient of Expansion - cc/cc/°C.	0.00070 (25°-65°C.)	0.00066 (25°-65°C.)
Density--		
Specific Gravity 25°/25°C. (77°/77°F.)	1.447 to 1.457	1.538 to 1.54
Pounds per Gallon 25°C. (77°F.)	12.08	12.83

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TABLE I. (continued)

	<u>Aroclor 1248</u>	<u>Aroclor 1254</u>
Distillation Range--ASTM D-20 (Mod.) Corr. °C.	340°-375°	365°-390°
Vaporization Rate gms/cm ² hr/100°C.	0.000152	0.000053
Flash Point--Cleveland Open Cup °C. °F.	193°-196° 379°-384°	None
Fire Point--Cleveland Open Cup °C.	None	None
Pour Point--ASTM D-97 °C. °F.	-7° 19.4°	10° 50°
Viscosity--Saybolt Universal Sec. (ASTM D-88)		
210°F. (98.9°C.)	36-37	44-48
130°F. (54.4°C.)	69-78	260-340
100°F. (37.8°C.)	185-240	1800-2500
Absolute Viscosity--Centipoises		
212°F. (100°C.)	4.2	8.5
122°F. (50°C.)	25	146
77°F. (25°C.)	208	777

V. NONCOMBUSTIBLE QUALITIES OF AROCLOR 1248

FLASH POINT. Limitations of this test for the prediction of the fire hazard of relatively nonvolatile organic fluids have been recognized by the ASTM committee (1).

FIRE POINT is a more significant measurement. The National Board of Fire Underwriters Laboratories (20) concur 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. (1,299°F.) determined by Sullivan, Wolfe and Zisman (19), using the convenient apparatus described by Sortman, Beatty and Heron (18).

Under industrial use conditions 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. In this connection, we wish to refer to an

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observation concerning the use of Aroclor 1248 as a noncombustible heat-transfer medium in Aroclor heating systems. An accidental failure in one of our Aroclor heating systems 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, causing the lower coil (steel) 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. Smoke arose from the heater but there was no internal fire. After the gas flame was cut off, the smoking stopped.

SPRAY FLAMMABILITY. When a line ruptures in a die-casting system where the hydraulic fluid is under relatively high pressure, a spray or mist prevails. The possible fire hazard of Aroclor 1248 under these conditions requires considerations not covered by the foregoing discussions relative to the material in the liquid form. In their comprehensive study, "Flammability of Higher Boiling Liquids and Their Mists", Sullivan, Wolfe and Zisman 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 fluid conducted at the Naval Proving Ground, Dahlgren, Virginia. The per cent oxygen requirement for Aroclor 1248 combustion in the spray flammability limit studies was established at 64%. It was observed that fluids requiring over 45-50% of oxygen in the spray test failed to cause a fire in the incendiary test. These results firmly establish the nonflammable and noncombustible qualities of Aroclor 1248. Moreover, these results on spray flammability studies seem most pertinent since they reflect conditions prevailing in the case of pressurized systems such as used in metal die-casting. Therefore, we are taking the liberty of presenting the data in the following Table II as taken from the publication by Sullivan, Wolfe and Zisman to compare this highly significant spray flammability rating given to selected chlorinated hydrocarbons, organic phosphates, etc. Benzene and a petroleum oil are included for comparison purposes.

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TABLE II. Flammability of Certain Higher Boiling Liquids and Their Mists

<u>Fluid</u>	<u>Viscosity Cs. at 100°F.</u>	<u>Flash Pt. (COC) (1) °F.</u>	<u>Fire Pt. (COC) (1) °F.</u>	<u>S.I.T.(2) °F.</u>	<u>Spray Flamma- bility Limit Oxygen</u>
Naval Ordnance hydraulic oil O.S. 1113	41.8	315	340	505	14
Benzene	0.58	12	-	1295	12
Chlorobenzene	0.59	90	-	-	14
o-Dichlorobenzene	0.84	165	-	-	29
1,2,4-Trichlorobenzene	1.1	260	None	>1000	44
Trichlorodiphenyl (Aroclor 1242)	17.7	350	633	1230	45
AROCLOR 1248 (Tetra- chlorodiphenyl)	45.4	380	None	1300	64
Diphenyl ether	2.6	265	275	-	11
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Dichlorodiphenyl ether	4.9	300	465	-	33
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Trimethyl phosphate	-	225	245	903	47
Tributyl phosphate	2.6	285	370	-	27
Trioctyl phosphate	8.1	380	465	680	13
Tricresyl phosphate	29	500	685	1170	19
Hexamethyl tetra- phosphate	38.3	>510	None	920	31
Tetrabutyl pyro- phosphate	8.9	465	720	845	14
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Diphenyl mono (p-tert- butyl phenyl) phos- phate	40.3	465	720	1076	12
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(1) Cleveland Open Cup

(2) Spontaneous ignition temperature

In light of the importance of spray flammability as demonstrated to be the most significant determination of the noncombustible qualities of higher boiling fluids and their mists, it is indeed interesting to note the lack of correlation between this value and other constants, such as

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VI. RESISTANCE OF STRUCTURAL MATERIALS TO AROCLOR 1248

The noncorrosive qualities of Aroclor 1248 and the strong resistance of structural materials to Aroclor 1248 are highly important factors in the practical use of Aroclor as a hydraulic medium in die-casting systems. The following Table III indicates the resistance of structural materials to Aroclors 1248 and 1254.

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	<u>25°C.</u>	<u>125°C.</u>	<u>25°C.</u>	<u>125°C.</u>
Aluminum	R	R	R	R
Copper	R	D	R	D
Magnesium	RR	R	R	R
Nickel	RR	R	R	RR
Silver	R	R	R	R
Tin	R	R	R	R
Zinc	R	R	R	R
Mild Steel	RR	R	RR	RR
Phosphor Bronze	R	D	R	R
Red Brass	D	D	R	D
Stainless Steel	RR	RR	RR	RR
Yellow Brass	R	Re	R	De

RR--Excellent resistance--less than 1.0×10^6 cm/day penetration or 0.00014 in/yr.

R -- Good resistance--has penetration between 1.0×10^6 and 10×10^6 cm/day or between 0.00014 and 0.0014 in/yr.

D --Doubtful resistance--has penetration between 10×10^6 cm/day and 100×10^6 cm/day or between 0.0014 and 0.014 in/yr.

e --Following the letter indicating resistance signifies material may be better than indicated if totally immersed since weight loss is believed to come from oxidation of the part of test strip exposed to air.

NVF 003223

VII. PACKING MATERIALS AND GASKETS SUITABLE
FOR USE WITH AROCLOR 1248 IN DIE-CASTING SYSTEMS

Results of accelerated laboratory tests show that Hycar P., Koroseal, Perbunan, Neoprene and various other "rubbers" are softened by Aroclors, especially at elevated temperatures. Accordingly, questions arise about the use of these materials for gaskets on die-casting machines using Aroclor. However, from practical experience in the operation of die-casting machines, it has been noted that fittings, such as the ball joints made by Chiksan Tool Company (3), containing a small Neoprene gasket have given very good service under long continuous use when installed in die-casting systems operated with Aroclor. Also, Neoprene lined, metalized flexible tubes used on the return lines of the die-casting machines appear to give good service with Aroclor. In some instances it appears almost necessary to use flexible tubes, especially on the return lines of the die-casting machines. If possible to do so, it would seem desirable to use rigid lines fitted with ball joints such as made by Chiksan or Barco Swivel Joints (2).

For pipe connection, welded joints are not necessary but in the case of welded flange connections, these may be satisfactorily gasketed by the use of a thin sheet of aluminum. Various packing materials suitable for use with Aroclor at elevated temperatures include Garlock Packing Company's (8) #7021, 1/8 inch asbestos fiber sheet for flange connections. Garlock's #117 braided packing is used in valves and Garlock #234 packing is used for pumps; also, Garlock #431 and Chevron 7050-C materials are suitable packings. Likewise, Durametallic (6) spiral asbestos fiber may be used. Doubtless, Johns-Manville Corp. (12) and others have comparable packing materials which would be suitable. In all instances, when ordering packing, it should be indicated to the supplier that the material is intended for use with Aroclor 1248.

Teflon, duPont's (7) polytetrafluoroethylene, is not attacked by hot Aroclor (130°C.) and is to be recommended as a gasket material. Thiokol is not attacked by Aroclors at ordinary temperatures and especially Thiokol 1605-A appears of interest for use with Aroclors in die-casting systems. The maximum temperature ranges at which Thiokol is suitable are indicated as follows:

Thiokol Type A - 150°-200°F. max.
Thiokol Type FA - 150°-200°F. max.
Thiokol Type ST - 250°-300°F. max.

Dow Corning's (5) Silastic, Silicone 180 is very resistant to hot Aroclor and use of this material is suggested. The changes in properties of Silicone 180 when immersed in hot Aroclor for 70 hours at 150°C. are summarized as follows:

NMF 003224

-
-
1. Lowering of the hardness by about 20 points.
 2. Improvement in the elasticity by several points.
 3. Practically no change in tensile strength
 4. An appreciable increase in the ultimate elongation.

Other types of packing materials recommended by the manufacturer for use in Aroclor installations include the following Palmetto (16) packings:

Hydraulic Service (Normal Temperatures)

Rod packing	- Palmetto Pyramid Packing #2510
U Ring packing	- Palmetto U Ring Packing #2610
Flange packing	- Palmetto Flange Packing #2810
Kup packing	- Palmetto Kup Packing #2710
Sheet packing & gaskets	- Palmetto H1-4 Sheet Packing #2910

Heat-Transfer Service

Rod packing	- Palmetto High Pressure Packing #2200
Sheet packing & gaskets	- Palmetto H1-4 Sheet Packing #2910

With reference to the manufacturer and also the user of die-casting equipment, it is highly advantageous if the same packing materials generally used with oil can be used also with Aroclor 1248. In this connection, in the case of the Oilgear Company hydraulic equipment, it is noted that such packings as Thiokol, which is used for gaskets, and Garlock #431, which is used as ram packings on most Oilgear equipment, can be used either with oil or with Aroclor 1248.

Vickers, Incorporated advise that all packing materials will have to be other than those normally used for petroleum base fluids to prevent rapid deterioration, and these are available through Vickers, Incorporated for their own equipment, or many of the suppliers of standard sealing elements.

VIII. LUBRICATION

Aroclor 1248 has lubricating properties and is used in die-casting systems most frequently without the addition of added lubricants. However, in the case of piston type pumps where high lubricity is a requirement, sometimes the practice is to add not more than 5% of a high lubricity oil to the Aroclor. Oils of this type in use are DTE medium heavy high lubricity oil and Pennsylvania Refining Company's (17) #90 VI light stock oil. Other similar oils are available for this purpose.

NVF 003225

Aroclor 1248 is recognized in the industry as an EP lubricant and its heavy load carrying quality without seizure is reflected by tests made with a hydraulic fluid containing a substantial proportion of Aroclor. The data pertains to results with an Almen test machine. During the standard test, the hydraulic fluid carried the full 30-pound load normally used as maximum on the Almen test. The torque at maximum load passed, average of 2 runs, was found to be 28.5 for the hydraulic fluid built on Aroclor as compared with a value of 14.0 for SAE 10 motor oil.

IX. VISCOSITY

The viscosity of Aroclor 1248 seems to be within the range required in the normal operation of many industrial pumps and hydraulic equipment. As previously indicated, the viscosity of Aroclor 1248 can be increased by the addition of Aroclor 1254. In light of the influence of temperature on the viscosity of Aroclor, this factor should be given consideration with reference to the operation of the pumps or hydraulic system in which Aroclor is used.

As a general indication of the viscosity requirements for different types of pumps, Vickers, Incorporated specifies the following for use with its pumps:

Industrial Machinery Installations (Ambient Temperature 50°F. to 90°F.)

	<u>Type of Installation</u>	<u>Oil Viscosity</u>
Vane Type Pumps	Machine tools operating at pressures up to 1000 p.s.i.	150-225 S.S.U. @ 100°F.
	Presses and other heavy machinery	275-315 S.S.U. @ 100°F.
Piston Type Pumps	All industrial machinery	275-315 S.S.U. @ 100°F.
Piston Type and Gear Type Fluid Motors	All industrial machinery	150-315 S.S.U. @ 100°F.

Vickers recommends that the oil temperatures in the hydraulic circuit should be maintained between 60° and 130°F. If, for reasons of non-operation for extended periods, the temperature drops below 60°F., the fluid should be warmed to that temperature before starting operations.

NVF 003226

Coolers should be provided to prevent temperatures in excess of 130°F., which will comply with the temperatures demanded by the Joint Industry Conference Hydraulic Standards, and should also avoid the necessity of having to use vent ducts from any open or semi-open reservoir.

Referring to the fact that the specific gravity of Aroclor 1248 is greater than the similar value of average petroleum base fluids used, inlet conditions to pumps should be carefully scrutinized to insure the absence of cavitation.

X. FILTRATION

It seems prudent to maintain clean oil regardless of the specific hydraulic fluid used in die-casting systems. Small particles of dirt metal chips and sand from the castings seem to work their way into the hydraulic fluid whether the installation is a new one or one that has been in service for many years. Aroclor 1248 has a tendency to suspend such impurities. Although it is not always practiced, nevertheless, it seems important to provide adequate filtration so that abrasive particles are removed from the system and the Aroclor 1248 is kept clean.

Many die-casting machines are equipped with internal fine mesh wire screens. These filters are suitable for removing the larger particles but to keep the Aroclor in a satisfactory clean condition, the recommendation is to filter the Aroclor through a bed of suitably processed granular Fuller's earth. There are available a number of satisfactory filtering mechanisms or oil purifiers which may be used continuously or intermittently. Probably one of these filters available as a convenient portable model would be the most economical as it could be used to clean the oil in a number of die-casting machines. As one example of a supplier of such equipment, we wish to refer to the Honan-Crane Corporation (10).

XI. DERMATOLOGY AND TOXICOLOGY

Results of standard skin patch tests using over 100 individuals show that Aroclor 1254 is neither a skin irritant nor a skin sensitizer (14). We would expect that these results would serve to indicate that Aroclor 1248, which is only slightly lower in chlorine content than Aroclor 1254, is also neither a skin irritant nor a skin sensitizer.

Although the vapor pressure of Aroclor 1248 is quite low and for all practical purposes the material is nonvolatile, nevertheless, when Aroclors are heated to elevated temperatures, vapors arise and these vapors bear a degree of toxicity and should not be breathed. This

NVF 003227

consideration is, of course, minimized in the case of using Aroclor 1248 in die-casting systems, which are necessarily thoroughly enclosed to prevent even the smallest kind of a leak, and the operating temperature is relatively low since practical operation never exceeds about 140°F.

Aroclor 1248 has been used for over ten years in individualized and centralized die-casting systems with complete freedom from any trouble or fear of any toxic effects. If Aroclor 1248 comes in contact with the worker's skin, the skin should be washed in an ordinary manner with soap and water. If the Aroclor is sufficiently hot so as to cause a burn when in contact with the skin, the burn should be treated in the same manner as any ordinary burn. Aroclor adhering to the burned area need not be removed immediately unless treatment of the burn demands it, in which case soap and water or repeated washings with a vegetable oil is recommended.

* * * *

MONSANTO CHEMICAL COMPANY
St. Louis 4, Mo.

New York-Chicago-Boston-Birmingham-Charlotte-Cincinnati-Cleveland
Detroit-Philadelphia-Los Angeles-San Francisco-Montreal

PGB:ag M-550 Rev.

Printed in U.S.A.

NVF 003228

BIBLIOGRAPHY

- (1) Am. Soc. Testing Materials, Proc. Am. Soc. Testing Materials, 34, 53 (1934).
- (2) Barco Manufacturing Co., 1801-15 Winnemac Ave., Chicago, Illinois.
- (3) Chiksan Tool Company, Brea, California.
- (4) Cleveland Automatic Machine Co., 4900 Beech Street, Cincinnati 12, Ohio.
- (5) Dow Corning Corp., 592 Saginaw Road, Midland, Michigan.
- (6) Durametallic Corp., 1936 Hall Street, Kalamazoo 24-F, Michigan.
- (7) E. I. duPont de Nemours & Co., Inc., Wilmington 98, Delaware.
- (8) Garlock Packing Company, 250 Main Street, Palmyra, New York.
- (9) H. L. Harvill Mfg. Co., Harvill Building, Corona, California.
- (10) Honan-Crane Corporation, Lebanon, Indiana.
- (11) The Hydraulic Press Mfg. Co., 830 Marion Road, Mount Gilead, Ohio.
- (12) Johns-Manville, 22 East 40th Street, New York 16, New York.
- (13) Lester Engineering Co., 2711 Church Street, Cleveland 13, Ohio.
- (14) Monsanto Chemical Co. Technical Bulletin No. P-115, "The Aroclors."
- (15) The Oilgear Company, 1560 W. Pierce St., Milwaukee 4, Wisconsin.
- (16) Palmetto Packings made by Greene, Tweed & Co., N. Wales, Penna.
- (17) Pennsylvania Refining Company, 2686 Lisbon Ave., Cleveland, Ohio.
- (18) Sortman, C., Beatty, H., and Heron, S., Ind. Eng. Chem., 33, 357 (1941).
- (19) Sullivan, M. V., Wolfe, J. K., and Zisman, W. A., Ind. Eng. Chem., 39, 1607 (1947).
- (20) Underwriters' Laboratories, "Miscellaneous Hazards No. 2498", Chicago, Illinois, 1934.
- (21) Vickers, Incorporated, 1402 Oakman Blvd., Detroit 32, Michigan.
- (22) The Watson-Stillman Co., 109 Aldene Road, Roselle, New Jersey.

NVF 003229



NVF 003230

SALES SUMMARY
PRODUCTS FORMULATED WITH PCB
NVF CO - WILMINGTON
1954 - 1977



1954 - 1957

Sales books are incomplete for these years.

0 lbs.

1958 - 1964

No sales found for these years.

0 lbs.

1965

Aroclor Dist. 1254

0 lbs. *

1966 - 1977

No sales found for these years.

0 lbs.

NVF 000001

* Sales for these years are rounded off to the nearest thousand pounds. Sales less than 500 pounds are recorded as 0 pounds.

SALES SUMMARY — PRODUCTS 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 1968		PAGE NO 157					
DATE	SALES MAN	PROD 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
			041040 280 Aroclor Dist 1254																	

1502 0507783 NVF CO WILMINGTON

0005

5

NVF 000002

SALES SUMMARY
PRODUCTS FORMULATED WITH PCB
NATIONAL VULCANIZED FIBER (NVF) - UNKNOWN LOCATION
1954 - 1977

1954 - 1957

Sales books are incomplete for these years.

0 lbs.

1958

No sales found for this year.

0 lbs.

1959

Aroclor Dist. 1254

150 lbs.

1960

Aroclor Dist. 1254

4,000 lbs. *

Pydraul F-9

2,000 lbs. *

Aroclor Dist. 1248

22,000 lbs. *

1961

Aroclor Dist. 1254

0 lbs. *

Pydraul F-9

1,000 lbs. *

Aroclor Dist. 1248

9,000 lbs. *

1962

Aroclor Dist. 1254

25,200 lbs.

Pydraul F-9

59 lbs.

Aroclor Dist. 1248

3,000 lbs.

1963

Aroclor Dist. 1254

4,800 lbs.

Aroclor Dist. 1268

250 lbs.

Pydraul F-9

59 lbs.

1964

Therminol FR-2

0 lbs. *

1965 - 1977

No sales found for these years.

0 lbs.

NVF 000003

- * Sales for these years are rounded off to the nearest thousand pounds.
Sales less than 500 pounds are recorded as 0 pounds.

SALES SUMMARY

2 A	#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL D. PLASTICS DIVISION CHEMICAL DISTRICT		#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY		#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL D. PLASTICS DIVISION CHEMICAL DISTRICTS		#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL CHEMICAL ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY		MONTH DEC	YEAR 59	PAGE NO. 164
	OH 1040 280 AROCLOR DIST. 1254				SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS		TOTAL SALES LAST YEAR POUNDS DOLLARS		

B	515447	15	03	NATL VULCANIZED FIBR	50	20	150	59		
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NVF 000004

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 DEC		YEAR 1960		PAGE NO 152					
Dist	SALES MAN	PROD GRP	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.
			04 1040 280 AROCLOR DIST 1254																	

1503 | B515447 NATL VULCANIZED FIBR

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NVF 000005

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		447							
DIST	SALES MAN	PROD CDP	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															

15 2 3 515447 NATL VULCANIZED FILR

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1

1

NVF 000006

SALES SUMMARY — POUNDS 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 DEC		YEAR 1960		PAGE NO 469					
DATE	SALES MAN	PROD GRP	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.
			11 1040 260 AROCLOR DIST 1248																

1503| B515447 NATL VULCANIZED FIBR

22

14

5

2

NVF 000007

[illegible]

SALES SUMMARY — POINTS 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 DEC		YEAR 1962		PAGE NO 452					
DIST	SALES MAN	PROD GRP	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.

1503] A15447 NATL VULCANIZED FIBR

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1-

NVF 000009

10 4590 009 PYDRAUL F-9

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 DEC			YEAR 1962		PAGE NO 472		
DIST	SALES MAN	PROD GRP	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.

1503	AB15447	NATL VULCANIZED FIBR	9	4	3				3											
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NVF 000010

11	1040	260	AROCOR	DIST	1248															
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SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL CHEMICAL DISTRICT	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL CHEMICAL DISTRICTS	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL CHEMICAL ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY	MONTH DEC	YEAR 1963	PAGE NO. 154		
	04 1040 280 AROCLOR DIST 1254				SALES THIS MONTH		SALES THIS YEAR TO DATE		
				POUNDS		DOLLARS		TOTAL SALES LAST YEAR	
								POUNDS	
								DOLLARS	

15 02 A 515447 NATL VULCANIZED FIBR

4,800

1,073

25,200

5,481

NVF 000011

SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER A GENERAL DISTRICT C RUBBER ACCOUNTS B AGRICULTURAL CHEMICAL DISTRICT D PLASTICS DIVISION	#2 PRODUCT SALES BY CUSTOMER A TOTAL ORGANIC SALES B RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A GENERAL DISTRICT C RUBBER ACCOUNTS B AGRICULTURAL CHEMICAL DISTRICTS D PLASTICS DIVISION	#4 CUSTOMER SALES BY PRODUCTS A ALL ORGANIC ACCOUNTS B AGRICULTURAL CHEMICAL ACCOUNTS ONLY C RUBBER ACCOUNTS ONLY	MONTH	YEAR	PAGE NO	
					DEC	1963	167	
04 1040 340 ARDCLOR DIST 1268			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR	
			POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS	DOLLARS

15 02 A 515447 NATL VULCANIZED FIBR

250

64

NVF 000012

SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL CHEMICAL DISTRICT D. PLASTICS DIVISION	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL CHEMICAL DISTRICTS D. PLASTICS DIVISION	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL CHEMICAL ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY	MONTH	YEAR	PAGE NO	
					DEC	1963		446
10 4580 009 PYDRAL F-9			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR	
			POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS	DOLLARS

15 02 A 515447 NATL VULCANIZED FIBR

59

44

NVF 000013

SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL CHEMICAL DISTRICT D. PLASTICS DIVISION	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT C. RUBBER ACCOUNTS B. AGRICULTURAL CHEMICAL DISTRICTS D. PLASTICS DIVISION	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL CHEMICAL ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY	MONTH	YEAR	PAGE NO	
					DEC	1963	400	
11 1040 240 AROCLOR DIST 1248			SALES THIS MONTH		SALES THIS YEAR TO DATE		TOTAL SALES LAST YEAR	
			POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS	DOLLARS

15 02 A 515447 NATL VULCANIZED FIBR

3,000

670

NVF 000014

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 NO. 163					
DIST	SALES MAN	PROD GRP	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.
			04 1040 280 AROCLOR DIST 1254																	

1502 A515447 NATL VULCANIZED FIBR

5 | 16 |

NVF 000015

SALES SUMMARY — P ENDS 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 NO. 174					
DIST	SALES MAN	PROD GRP	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.
			04 1040 340 ARDCLOR DIST 1268																	

1502 AB15447 NATL VULCANIZED FIRR

NVF 000016

SALES SUMMARY — PRODUCTS 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 NO. 473					
DATE	SALES MAN	PROD CITY	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.
			11 1040 265 THERMINO / FR-2																	

1502	A331850 NATIONAL VULCANIZED FIBR			5																
------	----------------------------------	--	--	---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NVF 000017

SALES SUMMARY
PRODUCTS FORMULATED WITH PCT
NATL VULCANIZED FIBR - UNKNOWN LOCATION
1954 - 1977

1954 - 1957

Sales books are incomplete for these years. 0 lbs.

1958 - 1961

No sales found for these years. 0 lbs.

1962

Aroclor 5460 High Sol 100 lbs.

1963 - 1977

No sales found for these years. 0 lbs.

NVF 000018

SALES SUMMARY — PO' 78 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 DEC		YEAR 1962		PAGE NO 181						
DIST	SALES MAN	PROD. QTY	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.

1503 A515447 NATL VULCANIZED FIBR

04 1040 480 Araclos Dist 5460

NVF 000019

SALES SUMMARY

DIRECT 2	#1 SALESMEN'S SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL CHEMICAL DISTRICT	#2 PRODUCT SALES BY CUSTOMER A. TOTAL ORGANIC SALES B. RUBBER ACCOUNTS ONLY	#3 DISTRICT PRODUCT SALES BY CUSTOMER A. GENERAL DISTRICT B. AGRICULTURAL CHEMICAL DISTRICTS	#4 CUSTOMER SALES BY PRODUCTS A. ALL ORGANIC ACCOUNTS B. AGRICULTURAL CHEMICAL ACCOUNTS ONLY C. RUBBER ACCOUNTS ONLY	MONTH DEC	YEAR 1963	PAGE NO. 177
	04 1040 480 Aroclor 5460 High Sol				SALES THIS MONTH POUNDS DOLLARS		SALES THIS YEAR TO DATE POUNDS DOLLARS
						TOTAL SALES LAST YEAR POUNDS DOLLARS	

15 02 A 515447 NATL VULCANIZED FIBR

100

24

NVF 000020

WATER_PCB-SD0000074784

SALES SUMMARY
PRODUCTS FORMULATED WITH PCT
NVF COMPANY - KENNETT SQUARE, PA
1954 - 1977

1954 - 1957

Sales books are incomplete for these years. 0 lbs.

1958 - 1970

No sales found for these years 0 lbs.

1971

Aroclor 6062 38,500 lbs.

1972

Aroclor 6062 21,000 lbs.

1973 - 1977

No sales found for these years.
0 lbs.

NVF 000021

* Sales for these years are rounded off to the nearest thousand pounds.
Sales less than 500 pounds are recorded as 0 pounds.

B1131-A DIRECT #2
01/12/72

ORGANIC DIVISION SPECIALTY PRODUCTS
PRODUCT/CUSTOMER SALES REPORT

FOR DEC 1971

PAGE 305

- IN THOUSANDS OF POUNDS AND DOLLARS -

MA C. R.	SIS REP	NAME OF PRODUCT/CUSTOMER	POTENTIAL	LAST YEAR SALES	SALES GOAL FOR CURR. YEAR	SALES CURR. YTD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	CUST ID / MAJR GRD GP
		AROCOR 6062															01755A		1045-062-1
5345		NVF CU KENNETT SQ PA				38.5		.1	11.4			6.0	3.0		6.0	3.0	3.0	6.0	10055903

NVF 000022

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 52

TOTAL	MONTH	SALES	YTD	SALES	TOTAL LAST YEAR SALES	TOTAL YEAR	CUST ID
-------	-------	-------	-----	-------	-----------------------	------------	---------

NVF COMP WILMINGTON DE
NVF CO KENNETT SQ PA
5200 DISC PCB PCT

21,000

4,725

38,500

8,930

AR 507783

00048310
10055903
9998-003-17

NVF 000023

WATER_PCB-SD0000074787

01/01/73

PILL PETROLEUM ADDITIVES
PRODUCT/CUSTOMER SALES REPORT

FOR 1 1973

PAGE 364

-IN THOUSANDS OF POUNDS AND DOLLARS-

AS G L	SLS REP	NAME OF PRODUCT/CUSTOMER	POTENTIAL	LAST YEAR SALES	SALES GOAL FOR CURR. YEAR	SALES CURR. YTD.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	CUST ID / MAJOR GRP GP
		WATER PCB PCT															024428		9998-000-17

		NVF LL KENNETH SQ PA		21.0															10055903
--	--	----------------------	--	------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----------

NVF 000024

WATER_PCB-SD0000074788

CB 270
REV

Monsanto

INV

D U N 8/00 828 0003

DIV SALES

7

SHIPPER'S NO 566309	DISTRICT WA	DATE ENTERED 02-03-71	CUSTOMER'S ORDER NO 134-20P	INVOICE AND SHIPPING DATE 02-04-71	INVOICE NUMBER SL 2-0687
TERMS NET 30 DAYS				CAR INITIALS AND NO 02-04-71	

PREPAID OR COLLECT - ROUTING

COLLECT - BARNES CAREXAKERS

DELIVERY FOB

ANNISTON ALA

SHIPPED FROM ANNISTON	WHSE CODE 0009	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST FORM	02-020-507784
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NVF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348

SAME

0785-029-37-D-A-10055903

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
2 - 50 LB CANS -034 AROCLOR 6062 2-/-1-1045-062-17-0009-02-03 TINGLE JS	100. LB	.255 U	25.50

SHIPPING DATE	ARRIVAL DATE
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NVF 000025

SPECIAL INSTRUCTIONS

WATER_PCB-SD0000074789

CB 200
REV 7-70

Monsanto

INV

D-U-N 8/00 828 8803

DIV SALES

26

SHIPPER'S NO 566590	DISTRICT WL	DATE ENTERED 03-05-71	CUSTOMER'S ORDER NO 162-29P	INVOICE AND SHEETING 03-05-71	INVOICE NUMBER SL 3- 1068
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TERMS NET 30 DAYS	03-05-71	CAR INITIALS AND NO
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PREPAID OR COLLECT - ROUTING
COLLECT BARNES AKERS DELIVERY -CR

DELIVERY FOR
ANNISTON ALA

SHIPPED FROM ANNISTON	WHSE CODE 0009	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST FORM	02-020-507784
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SOLD TO
NVF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348

SHIPPED TO
SAME

0785-029-37-D-A-10055903

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
1 600 LB DRM -030 AROCOR 6062 2-/- 1-1045-062-17-0009-02-03	600. LB	.255 U	153.00
LW TINGLE			

SHIPPING DATE	ARRIVAL DATE
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SPECIAL INSTRUCTIONS

NVF 000026

Monsanto

INV

DIV SALES

SHIPPER'S NO 56666U	DISTRICT WL	DATE ENTERED 03-15-71	CUSTOMER'S ORDER NO. 171 96 P	INVOICE AND SHIPPING DATE 03-15-71	INVOICE NUMBER SL 3-2393
TERMS NET 30 DAYS				CAR INITIALS AND NO 03-15-71	

PREPAID OR COLLECT - ROUTING

COLL BARNES CARE AKERS CR

DELIVERY FOB

ANNISTON ALA

SHIPPED FROM ANNISTON	WHSE CODE UUU9	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST. FORM	02-020-507784
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NVF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348

SAME

U785-029-37-0-A-1005903

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
2 600 LB DRUMS -U3U AROCLOX 6062 2-/-1-1045-062-17-UU9-U2-U3	1200. LB	.255 U	306.00
TINGLE FM			

SHIPPING DATE

ARRIVAL DATE

NVF 000027

Monsanto

INV

DIV SALES

SHIPPER'S NO 566742	DISTRICT WL	DATE ENTERED 03-23-71	CUSTOMER'S ORDER NO. 181 168 P	INVOICE AND SHIPPING DATE 03-26-71	INVOICE NUMBER SL 3- 4528
TERMS NET 30 DAYS				CAR INITIALS AND NO 03-26-71	

PREPAID OR COLLECT - ROUTING

COLLECT BARNES CARE AKERS

DELIVERY F O B

ANNISTON AL

SHIPPED FROM ANNISTON	WHSE CODE 0009	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST. FORM 02-020-507784
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SOLO TO
SHIPPED TO

**NYF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348**

SAME

0785-029-37-0-A-10055903

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
16 600 LB DRUMS -030 AROCOR 6062 2-/- 1-1045-062-17-0009-02-03	9600. LB	.225 U	2160.00
M J TINGLE SS			

SHIPPING DATE	ARRIVAL DATE
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SPECIAL INSTRUCTIONS

NYF 000028

CB 207
REV 1

Monsanto

INV

OUN 5-00-620-4801

DIV SALES

32

SHIPPER'S NO 431600	DISTRICT	DATE ENTERED 05-14-71	CUSTOMER'S ORDER NO 1133 76 P	INVOICE AND SHIPPING DATE 06-01-71	INVOICE NUMBER SL 6- 0267
TERMS NET 30 DAYS				CAR INITIALS AND NO 06-01-71	

PREPAID OR COLLECT - ROUTING

COLL BARNES AKERS

DELIVERY FOB

ANNISTON AL

SHIPPED FROM ANNISTON	WHSE CODE 0009	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST FORM	02-020-507784
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**NVF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348**

**SAME
LAFAYETTE AND CEDAR STS**

0785-029-37-0-A-10055903

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 600 LB METAL R DRUMS -030 AROCLOR 6062 2-/-1-1045-062-17-0009-02-03 MADDOX FM	6000. LB	.225 U	1350.00

SHIPPING DATE	ARRIVAL DATE
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SPECIAL INSTRUCTIONS

NVF 000029

WATER_PCB-SD0000074793

Monsanto

INV

DIV SALES

14

SHIPPER'S NO 442793	DISTRICT	DATE ENTERED 07-23-71	CUSTOMER'S ORDER NO 1203-110P	INVOICE AND SHIPPING DATE 07-27-71	INVOICE NUMBER SL 7- 3001
TERMS NET 30 DAYS				CAR INITIALS AND NO 07-27-71	

PREPAID OR COLLECT - ROUTING

COL BARNES C/O AKERS

DELIVERY FOB

ANNISTON

SHIPPED FROM ANNISTON AL	WHSE CODE 0009	BOOKED THRU 5345	COPIES CODE 2-1-2	CUST FORM	02-020-507784
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NVF CO
LAFAYETTE & MULBERRY ST
KENNETT SQUARE PA 19348

SAME**0785-029-37-0-A-10055903**

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
5 600 LB METAL DRUMS -030 AROCLOR 6062 2-/-1-1045-062-17-0009-02-03 MT MADDOX	3000. LB	.235 U	705.00

SHIPPING DATE

ARRIVAL DATE

NVF 000030

Monsanto

MONSANTO COMPANY
LOUIS, MISSOURI 63166

INVOICE

DIVISION SALES

CUSTOMER'S ORDER NO.	DATE ENTERED	DATE SHIPPED	INVOICE DATE	INVOICE NO
1277-12P	10-04-71	10-15-71	10-15-71	14-10-10791

BILL TO
N.V.F. COMPANY
LAFAYETTE AND CEDAR ST
KENNETT SQUARE PA 19348

COPIES TO

SHIPPED TO
N.V.F. COMPANY
LAFAYETTE AND CEDAR ST
KENNETT SQUARE PA 19348

WHSE	BOOKED THRU	S DIV	TERMS	TYPE	MODE
0009	53-45	02	020		02
ACCTS. REC. NO.	CITY-STATE	CUSTOMER I D			
507783	0785-37	10C55903			
LOCK BOX 02					

PPD OR COL.	DELIVERY F.O.B.	TERMS OF PAYMENT	SHIPPER NO
COL	AS INDICATED BELOW	NET 30 DAYS	4552188
SHIPPED FROM		CAR NO. TT CARRIER	CUSTOMER SERVICE REPRESENTATIVE
ANNISTON AL			B DOLIMOUNT,

ITEM	DESCRIPTION, PRICE & UNIT	AMOUNT
1	5 600 LB METAL DRUM AROCLOK 6062 AT 3,000.00 LB 1045-062-17-0009-02-03-S-01755A .2350 FOB ANNISTON AL 3,000.00 LB	705.00
PAGE 1		705.00

NVF 000031

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WATER_PCB-SD0000074795

Monsanto

MONSANTO COMPANY
LOUIS, MISSOURI 63166

DIVISION SALES

INVOICE

CUSTOMER'S ORDER NO. 1306-25P		DATE ENTERED 11-03-71	DATE SHIPPED 11-04-71	INVOICE DATE 11-04-71	INVOICE NO. 14-11-14409
BILL TO N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	COPIES TO				
SHIPPED TO N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	WHSE 0009	BOOKED THRU 53-45	S DIV 02	TERMS 020	TYPE 02
	AGCTS. REC. NO. 507783	CITY-STATE 0785-37	CUSTOMER ID 10055903		
					LOCK BOX 02
PPD OR CQL COL	DELIVERY F.O.B. AS INDICATED BELOW	TERMS OF PAYMENT NET 30 DAYS			SHIPPER NO. 4610655
SHIPPED FROM ANNISTON AL	CAR NO./TT AL	CUSTOMER SERVICE REPRESENTATIVE B DOLIMOUNT.			
ITEM	DESCRIPTION, PRICE & UNIT				AMOUNT
1	5 600 LB METAL DRUM AROCLO 6062 AT 1045-062-17-0009-02-03-S-01755A FOB ANNISTON AL				3,000.00 LB .2350 705.00 3,000.00 LB
PAGE 1					705.00

NYF 000032

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WATER_PCB-SD0000074796

Monsanto

MONSANTO COMPANY
T. LOUIS, MISSOURI 63166

INVOICE

DIVISION SALES

CUSTOMER'S ORDER NO 1306-25P	DATE ENTERED 11-03-71	DATE SHIPPED 12-01-71	INVOICE DATE 12-01-71	INVOICE NO 14-12-18703
--	---------------------------------	---------------------------------	---------------------------------	----------------------------------

BILL TO N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	-2-1			
	COPIES TO			

SHIPPED TO N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	WHSE 0009	BOOKED THRU 53-45	\$ DIV 02	TERMS 020	TYPE 02	MODE 02
	ACCTS. REC. NO. 507783		CITY-STATE 0785-37		CUSTOMER I D 10055903	
	LOCK BOX 02					

PPD OR COL. COL	DELIVERY F.O.B. AS INDICATED BELOW	TERMS OF PAYMENT NET 30 DAYS	SHIPPER NO 4610663
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SHIPPED FROM ANNISTON AL	CAR NO. TT CARRIER	CUSTOMER SERVICE REPRESENTATIVE B DOLIMOUNT,
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ITEM	DESCRIPTION, PRICE & UNIT	AMOUNT
1	5 600 LB METAL DRUM 3,000.00 LB AROCLOR 6062 AT .2350 1045-062-17-0009-02-03-S-01755A FOB ANNISTON AL 3,000.00 LB	705.00
PAGE 1		705.00

NVF 000033

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Monsanto

MONSANTO COMPANY
ST. LOUIS, MISSOURI 63166

INVOICE

DIVISION SALES

CUSTOMER & ORDER NO.	DATE ENTERED	DATE SHIPPED	INVOICE DATE	INVOICE NO
1337-36P	12-14-71	12-21-71	12-21-71	14-12-22086

N.V.F. COMPANY
LAFAYETTE AND CEDAR ST
KENNETT SQUARE PA 19348

-2-1

N.V.F. COMPANY
LAFAYETTE AND CEDAR ST
KENNETT SQUARE PA 19348

WHSE	BOOKED THRU	S DIV	TERMS	TYPE	MODE
0009	53-45	02	020		02
ACCTS. REC. NO.	CITY-STATE	CUSTOMER I.D			
507783	0785-37	10055903			
LOCK BOX 02					

PPD OR COL.	DELIVERY F.O.B.	TERMS OF PAYMENT	SHIPPER NO.
COL	AS INDICATED BELOW	NET 30 DAYS	4685301
SHIPPED FROM	CAR NO./TT. CARRIER	CUSTOMER SERVICE REPRESENTATIVE	
ANNISTON AL		B DOLIMCUNT,	

ITEM	DESCRIPTION, PRICE & UNIT	AMOUNT
1	5 600 LB METAL DRUM AROCLOR 6062 AT 1045-062-17-0009-02-03-S-01755A FOB ANNISTON AL	3,000.00 LB .2350 3,000.00 LB 705.00
PAGE 1		705.00

C8206 ORC (REV 10-71)

NVF 000034

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WATER_PCB-SD0000074798

Monsanto**MONSANTO COMPANY**
ST. LOUIS, MISSOURI 63166**INVOICE****DIVISION SALES**

CUSTOMER'S ORDER NO.	DATE ENTERED	DATE SHIPPED	INVOICE DATE	INVOICE NO.
1355-16DP	12-21-71	01-04-72	01-04-72	14-01-23943

BILL TO O. CEDAR ST SM. 800 S.	N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	-2-1

BILL TO O. CEDAR ST SM. 800 S.	N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348	WHSE	BOOKED THRU	S DIV	TERMS	TYPE	MODE
		0009	53-45	02	020		02
		ACCTS. REC. NO.	CITY-STATE	CUSTOMER I.D.			
		507783	0785-37	10055903			
		LOCK BOX 02					

PPD OR COL.	DELIVERY F.O.B.	TERMS OF PAYMENT	SHIPPER NO.
COL	AS INDICATED BELOW	NET 30 DAYS	4699237
SHIPPED FROM	CAR NO./TT. CARRIER	CUSTOMER SERVICE REPRESENTATIVE	
ANNISTON AL		A WICKEY	

ITEM	DESCRIPTION, PRICE & UNIT	AMOUNT
1	25 600 LB METAL DRUM AROCLOR 6062 AT 15,000.00 LB 1045-062-17-0009-47-03-S-01755A .2250 FOB ANNISTON AL 15,000.00 LB	3,375.00
PAGE 1		3,375.00

10711
NVF 000035

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WATER_PCB-SD0000074799

Monsanto

MONSANTO COMPANY
ST. LOUIS, MISSOURI 63166

INVOICE

DUPLICATE

CUSTOMER'S ORDER NO. 1356-179P		DATE ENTERED 01-12-72	DATE SHIPPED 01-13-72	INVOICE DATE 01-13-72	INVOICE NO. 14-01-26064
BILL TO	N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348		PLEASE MAKE CHECKS PAYABLE TO: MONSANTO COMPANY MAIL TO P.O. BOX LISTED BELOW MONSANTO COMPANY BOX 360478M PITTSBURGH PENNSYLVANIA 15230		
	N.V.F. COMPANY LAFAYETTE AND CEDAR ST KENNETT SQUARE PA 19348				
SHIPPED TO			INQUIRIES		
PPD OR COLLECT CCL		DELIVERY F.O.B. AS INDICATED BELOW	TERMS OF PAYMENT NET 30 DAYS		SHIPPER NO. 4736542
SHIPPED FROM ANNISTON AL		CAR NO./TT CARRIER	CUSTOMER SERVICE REPRESENTATIVE B CULMOUNT,		

ITEM	DESCRIPTION, PRICE & UNIT	AMOUNT
1	10 600 LB METAL DRUM ARJCLOR 6062 AT 1045-062-17-0009-47-03-5-01755A FUB ANNISTON AL	6,000.00 LB .2250 1,350.00 6,000.00 LB
PAGE 1		1,350.00

NMF 000036

TERMS AND CONDITIONS: NOTWITHSTANDING ANY INCONSISTENT OR ADDITIONAL TERMS THAT MAY BE EMBODIED IN YOUR PURCHASE ORDER, WE ACCEPT YOUR ORDER, SUBJECT ONLY TO THE TERMS OF THE WRITTEN CONTRACT BETWEEN US UNDER WHICH YOUR ORDER IS PLACED. IF NO SUCH CONTRACT EXISTS, WE ACCEPT YOUR ORDER ONLY ON THE EXPRESS CONDITION THAT YOU ASSENT TO THE TERMS CONTAINED ABOVE AND ON THE REVERSE SIDE HEREOF, AND YOUR ACCEPTANCE AND RECEIPT OF THE GOODS SHIPPED HEREUNDER SHALL CONSTITUTE ASSENT TO SUCH TERMS.

WATER_PCB-SD0000074800

TERMS AND CONDITIONS

1. **FORCE MAJEURE.** Deliveries may be suspended by either party in case of Act of God, war, riots, fire, explosion, flood, strike, lockout, injunction, inability to obtain fuel, power, raw materials, labor, containers, or transportation facilities, accident, breakage of machinery or apparatus, national defense requirements, or any cause beyond the control of such party, preventing the manufacture, shipment, acceptance, or consumption of a shipment of the goods or of a material upon which the manufacture of the goods is dependent. If, because of any such circumstance, Seller is unable to supply the total demand for the goods, Seller may allocate its available supply among itself and all of its customers, including those not under contract, in an equitable manner. Such deliveries so suspended shall be cancelled without liability, but the contract shall otherwise remain unaffected.
2. **BUYER'S CREDIT.** Seller reserves the right, among other remedies, either to terminate this contract or to suspend further deliveries under it in the event Buyer fails to pay for any one shipment when same becomes due. Should Buyer's financial responsibility become unsatisfactory to Seller, cash payments or satisfactory security may be required by Seller for future deliveries and for goods theretofore delivered.
3. **WEIGHTS AND CONTAINERS.** In the case of bulk carload, tank car, or tank truck shipments, shipper's weights shall govern. Where shipment requires use by Seller of carboys, drums, barrels or other returnable containers, title to such containers shall remain in Seller and a deposit in the amount required by Seller must be made at the time the goods are paid for. Such container must be kept in good condition and may not be used for any material other than that shipped therein and must be returned within sixty (60) days from date of shipment. On such containers being so returned in good condition, a refund of the deposit will be made.
4. **SHIPMENTS.** The quantity shipped in any contract month may be limited by Seller to either: (a) the average of the monthly quantities ordered by Buyer hereunder for the preceding contract months, or (b) the maximum quantity covered by this contract divided by the number of months in the contract period. Seller shall not be bound to tender delivery of any quantities for which Buyer has not given shipping instructions.
5. **WARRANTY.** Unless otherwise provided herein, Seller warrants title and that all goods sold hereunder shall conform to Seller's standard specifications. Subject to the preceding sentence and except as otherwise expressly stated herein, SELLER MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO THE GOODS, whether used alone or in combination with other substances. Seller shall not be liable for, and Buyer assumes responsibility for, all personal injury and property damage resulting from the handling, possession or use of the goods by Buyer.
6. **LIMIT OF LIABILITY.** All claims for alleged defective goods, shortage or other cause shall be deemed waived unless made in writing and received by Seller within fifteen (15) days after Buyer learns of the alleged defect, but in no event later than sixty (60) days after Buyer's receipt of the goods. Buyer's exclusive remedy shall be for damages, subject, however, to Buyer's agreement that for any and all losses or damages resulting from any cause whatsoever including alleged defective or damaged goods, Seller's liability shall in no event exceed the purchase price thereof, or at the election of Seller, the repair or replacement of such defective or damaged goods. In no event shall Seller be liable for incidental or consequential damages. Transportation charges for the return of goods shall not be paid unless authorized in advance by Seller.
7. **PATENTS.** Seller warrants that any goods sold pursuant to this contract, except as are made specifically for Buyer according to Buyer's specifications, do not infringe any valid U.S. patent. This warranty is given upon condition that Buyer promptly notify Seller of any claim or suit involving Buyer in which such infringement is alleged, and if Seller is affected, that Buyer permit Seller to control completely the defense or compromise of any such allegation of infringement. Seller does not warrant that the use of any goods sold hereunder, or articles made therefrom, either alone or in conjunction with other materials, will not infringe a patent.
8. **FREIGHT - TAXES.** Any increase in freight rates paid by Seller on shipments covered by this contract and any tax or governmental charge or increase in same hereafter becoming effective increasing the cost to Seller of producing, selling, or delivering the goods or of procuring materials used therein, and any tax now in effect or increase in same payable by the Seller because of the sale of the goods, such as Sales Tax, Use Tax, Retailer's Occupational Tax, Gross Receipts Tax, may, at Seller's option, be added to the price herein specified.
9. **LOSS IN TRANSIT.** In case of breakage or loss in transit, Buyer shall have notation of same made on expense bill before paying freight.
10. **PLASTIC MATERIALS.** Because of the conditions involved in the manufacture of plastic materials, where an order calls for a product to be made up specially for Buyer:
 - (1) A delivery of not less than 90% of the order will be considered a complete fulfillment of the order.
 - (2) In case of an over-run, Seller may deliver and Buyer will accept any such excess up to 10% of the order, but not more than 1,000 pounds.
11. **FAIR LABOR STANDARDS ACT.** The material covered hereunder is warranted to have been produced in compliance with the requirements of the Fair Labor Standards Act of 1938, and with all amendments thereto.
12. **MISCELLANEOUS.** This contract is to be construed according to the laws of the State of Missouri. This document constitutes the full understanding of the parties, and no terms, conditions, understanding or agreement purporting to modify or vary the terms of this document shall be binding unless hereafter made in writing and signed by the party to be bound.

NVF 000037

WATER_PCB-SD0000074801

Monsanto

OSR

OUTBOUND SHIPPING REPORT

SHIPPER'S NO. 564332	DISTRICT WL	DATE ENTERED 7/23/70	CUSTOMER'S ORDER NO. 207-391-C	INVOICE DATE 8/13/70	INVOICE NUMBER
TERMS NET 30 DAYS				DATE SHIPPED 8/13/70	
PREPAID OR COLLECT - ROUTING					

COLLECT MALONE-CR
DELIVERY F.O.B.

ANNISTON ALABAMA

SHIPPED FROM ANNISTON	WHSE. CODE 09	BOOKED THRU	COPIES CODE	DIST. BLK. TRN 69 - 72 30	INDUSTRY CODE 51 - 54	STATE CODE 55 - 56
--------------------------	------------------	-------------	-------------	------------------------------	--------------------------	-----------------------

AMERICAN MINERAL SPIRITS COMPANY 23268
LA DIVISION OF UNION OIL COMPANY OF CALIFOR
3100 SOUTH MEACHAM ROAD
PALATINE ILLINOIS 60067

ACCOUNTING DISTRIBUTION

DIV	PLT	MAIN	SUB	CLASS	AMOUNT
14	15-16	17-19	20-21	22-24	31-39

NVF COMPANY
LAFAYETTE AND CEDAR STREET
KENNETT SQUARE PENNSYLVANIA
ORDER NO. 197-89P

DESCRIPTION

QUANTITY

PRICE & UNIT

DIV PLT

OUTWARD FRT.
704.01

54- 600 LB DRS-30

STEEL

AROCLOR 1254

1040-280-04-09

32400 LBS

35100- 2700- 32400

LESS DISTRIBUTOR DISC 5 PCT

EXHIBIT NO. 26

8-27-97
N. KUNCAITIS

DEST. WHSE.	KIND
57-60	61
MODE	POOL
76	79

TOTAL

PLANT NOTES

PREPAIDS: MAIL TO TRAFFIC

COLLECTS: REQUIRING FREIGHT RATES:
MAIL TO TRAFFICCOLLECTS: NOT REQUIRING FREIGHT RATES:
DESTROY

FREIGHT BILL

NUMBER	DATE PAID	RATE	TOTAL AMOUNT

WEEK OF AUGUST 10- CR STENCIL PRODUCT NAME AND LOT NUMBER
ON TOP AND SIDES OF ALL DRMS INCLUDE B/L WITH SHIPMENT WHICH STATES
QUANTITY AND TYPE PLASTICIZERS PLS KEEP ALL CONTAINERS OF ONE PRODUCT
TOGETHER SHOW P O NO 197-89P ON ALL DRUMS

NVF 000112

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63187
Phone: (314) 684-1000

June 16, 1986

Dr. William Lair
NVF Company
Lafayette & Mulberry Streets
Kennett Square, PA 19348

Dear Dr. Lair:

Confirming our phone discussion today, the results of our search of available sales documents related to our former PCB related products are summarized in the attached tables.

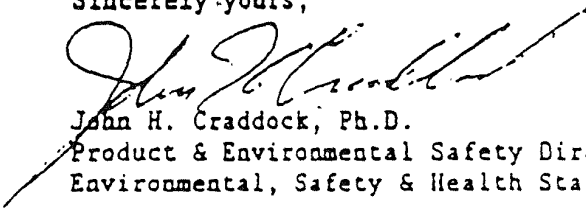
Our search included the following items:

- NVF Company - Kennett Square, PA
- National Vulcanized Fiber - all locations
- Time period 1954-1977

Sales records of this duration are not usually maintained as a routine course, therefore, I am not sure of their completeness. However, a record of a sale does indicate the trade did occur. A void does not necessarily mean no sales occurred, it only means no records are still available.

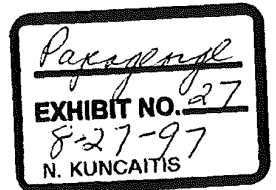
If I can be of further assistance, please let me know.

Sincerely yours,

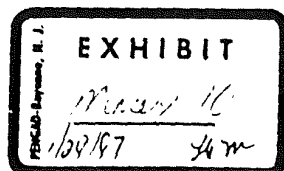

John H. Craddock, Ph.D.
Product & Environmental Safety Director
Environmental, Safety & Health Staff

314-614-4764

ve



5/27/86 Told to Dr. Kaley



10029

RECEIVED

JUN 20 1986

SALES SUMMARY

NATIONAL VULCANIZED FIBER

ALL LOCATIONS SEARCHED 1954 - 1977

1954 - 1957

Sales Summary books are incomplete for these years 0 lbs.

1958

No sales found for this year 0 lbs.

1959

Aroclor 1254 (HEAT TRANSFER FLUID) 150 lbs.

1960

Aroclor 1254 (HEAT TRANSFER FLUID) 4,000 lbs.
F-9 Pydraul (contained 52% Aroclor 1248) (HYDRAULIC FLUID) 2,000 lbs.
Aroclor 1248 (HEAT TRANSFER FLUID) 22,000 lbs.

1961

Aroclor 1254 0 lbs.
Aroclor 5460 (PLASTICIZER) R-TERPAEN Y- 0 lbs.
Pydraul F-9 1,000 lbs.
Aroclor 1248 9,000 lbs.

1962

Aroclor 1254 25,200 lbs.
Aroclor 5460 100 lbs.
Pydraul F-9 59 lbs.
Aroclor 1248 3,000 lbs.

1963

Aroclor 1254 4,800 lbs.
Aroclor 1268 (PLASTICIZER) 250 lbs.

SALES SUMMARY

NVF COMPANY - KENNETT SQUARE, PA

1954-1977

1954 - 1957

Sales Summary Books are incomplete for these years 0 lbs.

1958 - 1970

No sales found for these years 0 lbs.

1971

Aroclor 6062 (contained 38% Aroclor 1221) 38,500 lbs. (Plastic)
Balance chlorinated terphenyl

1972

Aroclor 6062 21,000 lbs. (Plastic)

1973 - 1977

No sales found for these years 0 lbs.

10031

SALES SUMMARY
NATIONAL VULCANIZED FIBER
ALL LOCATIONS SEARCHED 1954 - 1977

1954 - 1957

Sales Summary books are incomplete for these years 0 lbs.

1958

No sales found for this year 0 lbs.

1959

Aroclor 1254 (HEAT TRANSFER FLUID) 150 lbs.

1960

Aroclor 1254 (HEAT TRANSFER FLUID) 4,000 lbs.
F-9 Pydraul (contained 52% Aroclor 1248) (HYDRAULIC FLUID) 2,000 lbs.
Aroclor 1248 (HEAT TRANSFER FLUID) 22,000 lbs.

1961

Aroclor 1254 0 lbs.
Aroclor 5460 (PLASTICIZER) R TERPACRYL 0 lbs.
Pydraul F-9 1,000 lbs.
Aroclor 1248 9,000 lbs.

1962

Aroclor 1254 25,200 lbs.
Aroclor 5460 100 lbs.
Pydraul F-9 59 lbs.
Aroclor 1248 3,000 lbs.

1963

Aroclor 1254 4,800 lbs.
Aroclor 1268 (PLASTICIZER) 250 lbs.

10030

SALES SUMMARY

NVF COMPANY - KENNETT SQUARE, PA

1954-1977

1954 - 1957

Sales Summary Books are incomplete for these years 0 lbs.

1958 - 1970

No sales found for these years 0 lbs.

1971

Aroclor 6062 (contained 38% Aroclor 1221) 38,500 lbs. (PLASTIC)
Balance chlorinated terphenyl

1972

Aroclor 6062 21,000 lbs. (PLASTIC)

1973 - 1977

No sales found for these years 0 lbs.

10031

NAME

ADDRESS

DATE
MAILED

PER



45. N.V.F. Company

Lafayette & Cedar St.
Kennett Square, Pa. 19348

12-30-71 huc

NVF 000111



October 12, 1970

Dear

Perhaps you are aware of the polychlorinated biphenyl (PCB) environmental pollution problem. If not, then the attached material should provide background information.

The significance of this information is no longer can we dump scrap Aroclor or spent transformer oil down the sewer. Indiscriminate dumping of such material can lead to serious repercussions for the electrical industry. For this reason Monsanto is building an incinerator which will be ready some time during the first part of 1971.

Effective immediately, you may ship scrap material for incineration, at your expense, in 55 gal. drums, to the W. G. Ruppel Plant, Sauget, Illinois, Attention Supervisor, Dept. 246. We have tentatively set a 3¢ per lb. incineration charge. However, this is subject to change based on our operational experience with this unit.

Please use the attached label on all drums of scrap to be returned for incineration. These may be obtained, at no cost, by writing to the Supervisor, Dept. 246, W.G.K. Plant.

Additionally, we are working with the Rollins Purlo Company which is operating an incinerator in New Jersey. As soon as we can inspect this unit and give it our approval, we will negotiate a price for their service. Hopefully their charge will be in the 25¢ to 30¢ per gallon range including freight. This company hopes to construct similar units in 100 locations through out the United States.

In line with this program we would appreciate your supplying the number of gallons of scrap you expect to generate during 1971 and also a forecast for your 1971 Aroclor or transformer oil requirements.

Should you have additional questions concerning this matter, please contact me through the Monsanto Service Center currently handling your purchase orders.

NVF 003811

Many thanks for your cooperation on this matter. It will help us serve you better.

Cordially,

Randall Graham
Senior Fluids Specialist

RG:sg

Attachments:

1. Donald A Olson letter Feb. 18, 1970.
2. April 10, 1970 news release "Monsanto Replies to Charge That PCB Threatens Environment".
3. July 16, 1970 news release "Monsanto Sights Actions Taken on Environmental Issue".
4. "FDA Guideline for PCB's in Food". Elmer G. Wheeler July 24, 1970 (with his attachments).
5. Drum label for return of scrap material to Illinois plant.

NVF 003812

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 884-1000

February 18, 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.

NVF 003813

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 product used by any company should find their way into waterways.

We realize that you have marketed or may now market transformers and other electrical equipment containing dielectric fluids which include Aroclor® 1254 and 1260. Although these fluids are sealed into such equipment it is recognized that occasionally the fluid may be lost through leaks resulting from equipment misuse or equipment repair necessitating replacement of the fluid. Since the dielectric fluid contained in this equipment is only an incidental part of the over-all unit manufactured by you, we are not notifying the purchasers of such equipment of the potential environmental contamination problem described in this letter. We do recommend, however, that you notify such equipment users of this problem.

Sincerely yours,

Don Olson
Donald A. Olson
Director of Sales
Functional Fluids Group

1b

Attachment

NVF 003814

NEWS

FOR RELEASE

Monsanto

E. V. John
(314) 694-2891

PUBLIC RELATIONS DEPARTMENT
Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166

MONSANTO REPLIES TO CHARGE THAT PCB THREATENS ENVIRONMENT

ST. LOUIS, April 10 -- Monsanto Company said today it was well aware of the concern over possible environmental contamination by polychlorinated biphenyl (PCB), an industrial chemical made by the company. The company began a six-point program in 1968 to properly identify and measure PCB in the environment. Steps have been taken to strictly control use of the chemical and replace those grades of PCB which linger in nature.

Monsanto's statement came in response to charges by Congressman William F. Ryan (Dem.) of New York that the discovery of PCB in the ecology represented a major threat.

Howard L. Minckler, Monsanto vice president and general manager of its Organic Chemicals Division, said, "We have and will continue to cooperate fully with governmental agencies investigating this problem. We also have been in close contact with our customers. Monsanto has spent over \$1 million to verify or correct scientific reports, monitor the use of PCB and search for substitute products where needed. This program will be successfully concluded this year.

-more-

NVF 003815

--2 MONSANTO: REPLY TO PCB CHARGE xxx year.

"It is unfortunate that Congressman Ryan evidently did not have all this information at his disposal. Just last month we participated in a U.S. Department of the Interior meeting where we exchanged ideas with some 40 scientists and told them of our findings and actions," Minckler said.

The Monsanto executive also noted that the use of PCB is misunderstood by some investigators. "For example, we do not know of any current use of PCB in insecticides. Even so, we are asking the U.S. Department of Agriculture to reject any insecticide which has PCB as an inert carrier," Minckler said.

"PCB is not a household product, as some have suggested," Minckler continued. "To our knowledge, it is not used in plastic food wraps, house paints, cellophane, asphalt or tires. The principal market is electrical applications where the chemical performs a vital function as an insulating fluid. In this use, PCB is completely sealed in a metal container. Other major markets employ similar closed systems."

Monsanto's PCB program was initially directed at proper identification of chlorinated hydrocarbons appearing in the environment. This research, confirmed by others, found only the higher chlorinated materials. At the same time, Monsanto undertook animal feeding studies which show PCB is not a highly toxic material.

NVF 003816

-more-

--3 MONSANTO: REPLY TO PCB CHARGE XXXX material.

The second part of Monsanto's investigation was coordination with all customers and a rigid critique of its PCB manufacturing units. Although loss of PCB during manufacturing was negligible, production techniques were further modernized and new pollution abatement devices are continually being upgraded.

Monsanto has concentrated its further research on those few PCB compounds which degrade slowly. Alternate products for these grades, which retain the functional properties of PCB and present no potential threat, will be introduced later this year.

Minckler concluded, "Monsanto is seeking the best solution to this potential environmental problem. Action not based on reason and scientific facts can only result in greater problems. For example, we have been advised by one electrical equipment manufacturer that an immediate ban on PCB would result in major power failures throughout the world. This is not the answer. Proper use of this vital chemical and substitution, where appropriate, is the answer."

-oOo-

NVF 003817

NEWS

Monsanto

FOR RELEASE IMMEDIATELY 1970

E. V. John
(314) 694-2891
PUBLIC RELATIONS DEPARTMENT
Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63168

MONSANTO CITES ACTIONS TAKEN ON ENVIRONMENTAL ISSUE

ST. LOUIS, July 16 -- Monsanto Company, sole U.S. producer of an industrial chemical called polychlorinated biphenyl (PCB), today said recent political charges and sensational headlines about the chemical causing "a major ecological crisis" completely ignore voluntary actions the company has taken to restrict use of the material.

"Our program began back in 1968 with the proper identification and measurement of PCB in the environment and will conclude this year by our unilateral action to restrict its use," Howard L. Minckler, company vice president and general manager of its Organic Chemicals Division, said.

He added that Monsanto had not been pressured into action by any legislation or organized group. "We have taken decisive action based on evidence that PCB is a persistent chemical which builds up in the environment."

-more-

NVF 003818

--2 MONSANTO: MINCKLER'S REPLY TO PCB CHARGES xxx environment."

"Commenting on a recent report that PCB can induce birth defects in animals, Minckler said, "Monsanto is not aware of any scientific data that indicates polychlorinated biphenyls may cause birth defects. The results of comprehensive toxicity studies, sponsored by Monsanto and using the usual species of laboratory animals, have failed to produce such effects.

"Scare tactics and sensational reporting do not serve the public interest nor solve ecological problems," he said. "Only a few reports have stated why PCBs were ever developed and why they are used today. Nor have the consequences of not using PCB been explained.

"What should be emphasized," Minckler continued, "is that PCB was developed over 40 years ago primarily for use as a coolant in electrical transformers and capacitors. It is also used in commercial heating and cooling systems. It is not a 'household' item.

"Anyone who lives in a large city is familiar with power failures. During periods of peak power needs, air conditioning and refrigeration fail, lights go out and commuters are stranded. If power companies were to remove PCB from equipment, we have been told that major blackouts would occur throughout the world.

-more-

NVF 003819

--3 MONSANTO: MINCKLER'S REPLY TO PCB CHARGES xxx world.

"PCB is used in electrical equipment as a safety fluid. It has replaced combustible oil products which have, on many occasions, exploded and burned, causing deaths and injury to human life. Today state and local laws all over the country require the use of non-flammable fluids in certain electrical equipment as a safety feature. At the moment, there are no substitutes available which equal the safety performance of PCB."

Monsanto said it intends to continue selling PCB for "closed-system" uses such as electrical components and heat-transfer systems. "With rigid control over where the product goes, how it is handled and disposed of, we believe the safety functions of the product can continue to serve society and the environment can be protected," Minckler said. "We are discontinuing sales into 'open systems' -- adhesives, sealants, chlorinated rubber, specialty paints, etc.

"For other uses, such as fire-resistant hydraulic fluids, where PCB cannot be strictly controlled, we have reformulated some fluids and they are on the market. The new products contain other fire-resistant ingredients. We will continue to develop alternate formulations which do not contain persistent PCB. We will not abandon hydraulic fluid users," Minckler commented, "as has been reported."

-more-

NVF 003820

--4 MONSANTO: MINCKLER'S REPLY TO PCB CHARGE xxx reported."

Monsanto has also established a new system for disposal or recycle of spent PCB. A special high-temperature incinerator will break down PCB into harmless materials. The company also regenerates spent fluids for reuse. The incinerator will be offered to customers who cannot otherwise destroy or regenerate their old fluids.

"Although loss of PCB from our manufacturing plants has been negligible, we have further tightened up our production techniques and installed new pollution abatement devices," the Monsanto executive said.

"I repeat," Minckler concluded, "our program was initiated and conducted by Monsanto alone. It will be concluded this year. We believe it is a position any responsible company would take."

-oOo-

NVF 003821

Elmer P. Wheeler, Medical Dept.

July 24, 1970

FDA Guideline for PCB's in Foods

H. S. Bergen, ~~HEH~~

J. Mason, JNASO

W. B. Papageorge, WPAPA

J. E. Springate, JSPEI

FDA

P. J. Park

PPARK

Attached is a page from Food Chemical News of July 23, 1970, reference to the above subject.

This adoption of 'administration guideline levels' does not constitute a FDA regulation. It is, however, a basis for FDA regional offices and state food laboratories whether in departments of health or agriculture to seize and destroy (or declare unfit for human consumption) fish and milk which contain levels of PCB's above 5 ppm and 0.2 ppm respectively.

Elmer P. Wheeler

EPW:ju

Enclosure

NVF 003822

FOOD DATING legislation support from USDA was sought last week by Chairman Rosenthal (D-N.Y.) of the House Consumer Inquiry subcommittee. He wrote to USDA Secretary Hardin to request the Department to conduct a survey "to determine whether a statistically significant number of over-age perishable and semi-perishable food items are being sold by retail stores" and "whether the institution of expiration dates, or, in the alternative, the establishment of uniform codes known to consumers, would be effective in preventing the sale of old merchandise."

FATTY ACID labeling "statement of policy will issue shortly," FDA's M. J. Ryan, Director of Legislative Services, said in a letter to Rep. Yates (D-Ill.) (See FOOD CHEMICAL NEWS, July 13, Page 2). Ryan noted that FDA-ers have recently met with representatives of the National Heart and Lung Institute and of FTC to discuss the problem but said, "We are still not in a position to announce a formal policy." Yates had asked why "coconut oil could not be labeled as coconut oil rather than as vegetable oil."

THE CHEMICAL FEAST, James Turner's book criticizing FDA food regulation, has been published in paperbound, selling for 95 cents.

W. DONALD GRAY, who spearheaded many investigations of FDA as a member of the staff of Rep. Fountain's (D-N.C.) House Intergovernmental Relations subcommittee, is becoming an investigator for Sen. Magnuson's (D-Wash.) Senate Commerce Committee. For the past nine months, Gray has been a legislative assistant to Sen. McIntyre (D-N.H.).

SAIB was formally cleared by Canada's Food and Drug Directorate for use as a density adjusting agent for citrus-flavored beverages up to 50 p.p.m., in a Trade Information Letter (No. 336). A food standard proposal was submitted to FDA last week to clear optional use of sucrose acetate isobutyrate, and a Food Additive Petition has been submitted (See story, Page 27). SAIB is being considered as a substitute for brominated vegetable oils, which FDD last week formally limited to 15 p.p.m. in citrus-flavored beverages.

POLYCHLORINATED biphenyls surveillance program of FDA is being directed towards support of State efforts on PCBs (See FOOD CHEMICAL NEWS, June 29, Page 29). The agency has adopted administrative guideline levels for PCBs of 5 p.p.m. in fish and 0.2 p.p.m. in whole milk. FDA's surveillance for PCBs actually started last year; before seizing Coho salmon the agency analyzed for PCBs to see if the residues were DDT or PCBs (See FOOD CHEMICAL NEWS, March 31, 1969, Page 18). Milk containing PCBs has been found in Ohio and in Maryland, but these have been isolated instances, and in one case the PCBs were traced to a silo paint.

FDA budget for fiscal year 1971 was reported by the House Appropriations Committee at \$89.5 million, the amount of the Administration request.

FOOD ADDITIVE Petition filed by Geigy and noted July 17 would amend §121.2566 for antioxidants and/or stabilizers for polymers to clear use of 2-(3'-tert-butyl-5'-methyl-2'-hydroxyphenyl)-2H-5-chlorobenzotriazole in the manufacture of olefin polymers.

FDA'S Morton M. Schneider is switching from a Congressional relations post to the Office of Product Safety.

NVF 003823

FROM

SHIP TO

MONSANTO COMPANY
Department 246
SAUGET, ILLINOIS 62201

RETURNED

For Reclamation

or

Disposal only

RECEIVED

DATE

NVF 003824

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63168
Phone (314) 884-1000

December 15, 1971

Dear Sir:

We are writing to advise you that, effective this date, Monsanto will no longer sell the Therminol® FR series of heat transfer fluids. This important decision by Monsanto's management has been carefully considered.

The Therminol® FR series of fluids contain polychlorinated biphenyls (PCBs). As we have previously advised you, studies indicate PCBs may be accumulating in the environment. In some instances, PCBs have been found in food or in the food chain. An article by Carl G. Gustafson of the Federal Water Quality Administration appearing in "Environmental Science & Technology" and dealing with this subject is attached for your information.

Because of Monsanto's concern over this problem, we have discontinued sales of PCBs where the usage was in so-called "open systems." We have discontinued sales of Therminol® FR materials where the usage would be in food processing applications. In addition, we have encouraged Therminol® FR fluid customers to switch to other materials.

As a result of these efforts, many of our heat transfer fluid customers have switched from Therminol® FR series fluids to other materials or systems.

Our action in discontinuing sales for use in heat transfer systems has been taken because of the problems which may arise should there occur accidental leakage of PCBs from such systems. We believe this action is in the best interest of all our customers who have continued using these materials in heat transfer applications.

NVF 003839

a unit of Monsanto Company

WATER_PCB-SD0000074823

In order to help you accomplish a change-over from Therminol® FR to another heat transfer fluid with the least difficulty, Monsanto will offer you the following special services:

- 1) We have assembled a team of experienced engineers who will be available to visit your plant on request to consult with you on available alternatives. Of course, the decision is and will be yours as to how you elect to proceed. If you consider such a service would be of assistance to you, please telephone (314) 694-2514, or write directly to Dr. Cumming Paton, Monsanto Company, P. O. Box 14617, St. Louis, Missouri 63178.
- 2) We will pay freight costs incurred in returning the Therminol® FR to us and will properly dispose of the material (by high temperature incineration) at our cost. We will contact you concerning instructions about drainage, drumming and shipping of material to our facility in St. Louis.
- 3) We will accept return of any unopened drums of Therminol® FR series products which may be in your possession and credit you for this material at full purchase price if returned to us prior to March 1, 1972.

We sincerely regret any hardship that this decision may cause you, but feel you will agree Monsanto has made the correct decision.

Yours sincerely,



Howard Bergen, Director
Specialty Products Group
Monsanto Industrial Chemicals Company

Attachments ,

NVF 003840

feature

PCB's—prevalent and persistent

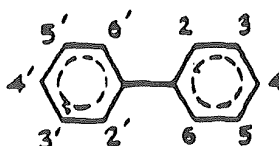
Intensified research is needed to minimize their dangers

Carl G. Gustafson, Federal Water Quality Administration, Athens, Ga.

During the past three years, a special class of compounds, called polychlorinated biphenyls (PCB's), has claimed the attention of ecologists and pesticide analysts in this country. These compounds were not discovered in the environment until 1966 in Sweden and 1967 in the U.S., despite the fact that they have been available commercially for 40 years. Interest in PCB's has arisen because they are frequently found in fish, bird, water, sediment, and other environmental samples when such samples are examined for chlorinated pesticide residues. That a wide variety of samples containing PCB's has been collected from England, Scandinavia, The Netherlands, Antarctica, Central America, and many different parts of the U.S. makes them truly ubiquitous pollutants.

Polychlorobiphenyls are made by substituting chlorine atoms for one or more of the hydrogen atoms at the

numbered positions of the biphenyl structure.



In the process of replacing hydrogen atoms with chlorine atoms, a large number of substitution combinations arise. For example, three monochlorobiphenyl isomers are possible, 12 dichlorobiphenyl isomers, 21 trichlorobiphenyl isomers, and so on. Theoretically, 210 compounds can be prepared by this substitution process; a typical example would be 2,4,6,2',4' pentachlorobiphenyl.

Whenever aromatic hydrocarbons such as biphenyls are chlorinated, the product is a mixture of compounds, including isomers. It is quite difficult to synthesize single, specific chlorobiphenyl compounds in the laboratory unless involved procedures are employed. Consequently few of the individual compounds have been prepared in the pure form for study.

In the commercial process for PCB manufacture, biphenyl is chlorinated with anhydrous chlorine in tall cylindrical towers with either iron filings or ferric chloride as the catalyst. The by-product is hydrogen chloride; the product is a mixture of several PCB's. The degree of chlorination is determined by measuring the specific gravity of the mixture or, when the product is more viscous, the ball-and-ring softening-point test is used. The whole process takes from 12 to 36 hours.

In the U.S., the sole manufacturer of PCB's is the Monsanto Co., which markets them under the trade name

Aroclor. PCB's are also manufactured in Europe and Japan, under trade names such as Phenochlor and Clophen. The various Aroclors are differentiated by a four-digit number, with the last two digits indicating the percentage of chlorine in the mixture.

Properties

The three most important physical properties of the PCB's are low vapor pressures (they have high boiling points), low water solubility, and high dielectric constants. They are miscible with most organic solvents and compatible with many types of polymers. Although some individual polychlorobiphenyl compounds are crystalline, the Aroclor mixtures are either liquids or resins.

The chemical properties that make PCB's desirable industrial materials are their excellent thermal stability, their strong resistance to both acidic and basic hydrolysis, and their general inertness. They are quite resistant to oxidation. Monsanto reports, in a technical bulletin on PCB's, that they can be heated to 140° C. under 260 p.s.i. of oxygen pressure "without showing any evidence of oxidation as judged by development of acidity or formation of sludge."

The physiological properties of the PCB's make them potentially significant contaminants of the environment. For any pollutant, two factors are involved: acute toxicity, which is immediately evident because of a high death rate or other maiming effect; and chronic toxicity, which is the result of a slow accumulation of the poison in the body and is a sublethal effect. Whenever acute toxicity is high, a pollutant will be readily recognized and appropriate remedial actions will be introduced. If, on the other hand, acute toxicity is low,

The Monsanto Co. stated recently in a letter to Congressman William F. Ryan of New York that as of August 30, it would no longer sell PCB's to customers for use in general plasticizer operations where disposal of the end-products cannot be controlled. After some lag period—the time it takes to eventually dispose of the products made from PCB's and currently in processor's inventories—the quantity of PCB's getting into the environment may be substantially reduced. If Monsanto's former customers look for PCB substitutes, rather than purchasing PCB's from manufacturers in Japan and Europe, the projected decrease could become a reality.

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the physiological effects will go unnoticed until the chronic effects make themselves evident. When this happens, the problem may have advanced beyond immediate or easy correction.

Acute toxicity

All studies of p.c.a.'s in animals indicate that acute toxicity is not a significant factor. Their acute toxicities are on the order of those of other chlorinated aromatic compounds. Monsanto has sponsored two investigations of the acute toxicities of Aroclor mixtures. In the first, at the Kettering Laboratory at the University of Cincinnati, Dr. J. F. Treon and his co-workers investigated the toxicity of Aroclor vapors for guinea pigs, mice, rabbits, and rats. All animals survived a 24-day exposure to 0.83 p.p.m. of Aroclor 1242 for 7 hours per day on 17 of those days. Even after more prolonged tests, there were no severe effects from Aroclor 1242. In the second investigation, still in process, three groups of beagles are fed Aroclor 1242, 1254, and 1260, respectively, at a rate of 100 p.p.m. in their diets. After three months no significant abnormalities have been noted.

Similar studies on fish have been performed in several laboratories. Dr. Richard Schoettger of the Sport Fisheries and Wildlife Fish-Pesticide Research Laboratory in Columbia, Mo., reports that 96 hour- TL_{50} toxicities of the Aroclors to trout range from 1.17 to 60 p.p.m. Compared to DDT, whose 96 hour- TL_{50} toxicity is 0.002 to 0.009 p.p.m. for trout, the p.c.a.'s have a relatively low acute toxicity. With the more sensitive bluegill, the 96 hour- TL_{50} for Aroclor 1248 is 0.278 p.p.m., while that of DDT is 0.008 p.p.m. Aroclor toxicities appear to be inversely proportional to the chlorine content of the mixture.

Shellfish, oysters, and shrimp are more sensitive to p.c.a.'s. Dr. Tom Duke, at the Bureau of Commercial Fisheries Pesticide Field Station, reports 100% mortality of juvenile pink shrimp exposed to 0.10 p.p.m. of Aroclor 1234 in water for 48 hours. This concentration of Aroclor 1234 will cause a 100% decrease in shell growth of oysters after 96 hours. To achieve the same effects with DDT in these experiments, only 0.0006 p.p.m. and 0.01 p.p.m., respectively, were required.

There is very little evidence that p.c.a.'s are toxic to insects. Studies to date show that they are less toxic than

dieldrin or DDT. As with fish, their toxicity appears to be inversely proportional to the chlorine content of the mixture.

Based on the above data, it is understandable why the polychlorobiphenyls, commercially available for 40 years, have only recently attracted attention as toxic environmental contaminants.

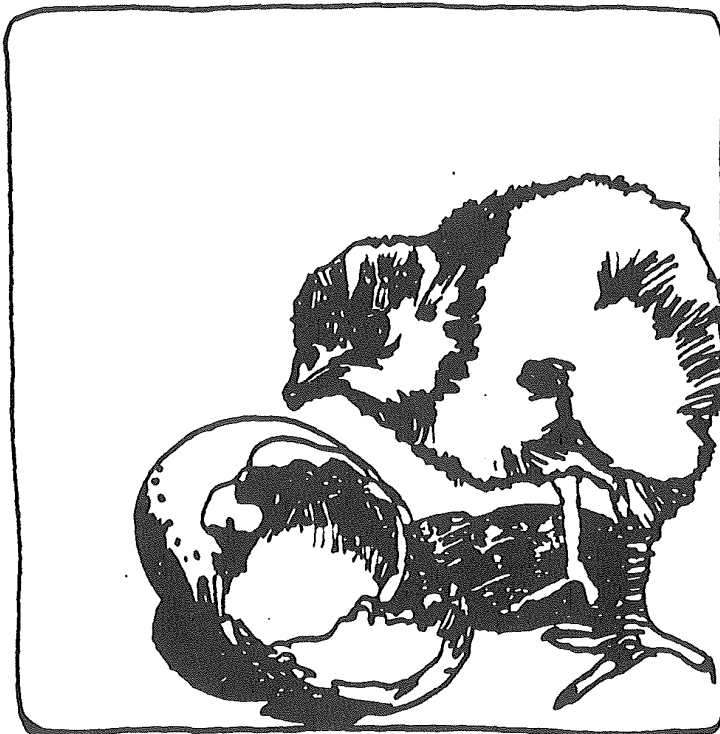
Chronic toxicity

The chronic toxicities of p.c.a.'s present a more disturbing situation; several chronic effects have been observed. It was discovered, quite by accident, that p.c.a.'s have a toxic effect on chickens. Professor E. L. McCune and his co-workers at the University of Missouri found their chickens dying after they were placed in a feeding house, parts of which had been freshly painted with an epoxy paint. Careful investigation revealed that the toxic factor was Aroclor 1242, a binder in the paint. When Aroclor 1242 was fed to the chicks it produced the same characteristic effects as chick edema factor. McCune reported: "Gross pathology included hydropericardium, hydropneumothorax, enlarged heart, liver, and kidneys, and hemorrhage of internal organs. Mi-

croscopically the kidneys showed marked tubular dilation and numerous casts."

Another chronic effect of p.c.a.'s is related in wildfowl. The accumulation of high concentrations of chlorinated hydrocarbons in birds resulted in disruption of normal breeding behavior and in the formation of thin-shelled eggs. A dramatic example of this effect has been observed in the case of the brown pelican. On the Anacapa Islands off the California coast, no young were hatched last year from 300 pairs of nesting birds. The shells of most eggs laid were so thin that a dent occurred when the egg was picked up.

There are two possible causes for the laying of thin-shelled eggs by wildfowl. One is a low calcium reserve in the bird; the other is the inability of the bird to deliver the needed calcium to its oviduct, where the eggshell is forming. The calcium level in the avian biosystem and the calcium reserve in the secondary bone structure or medullary bone, found only in female birds when they are breeding, are controlled by the hormone estrogen. A high estrogen level is associated with the formation of this calcium reserve. Chlorinated hydrocarbons, such as DDT,

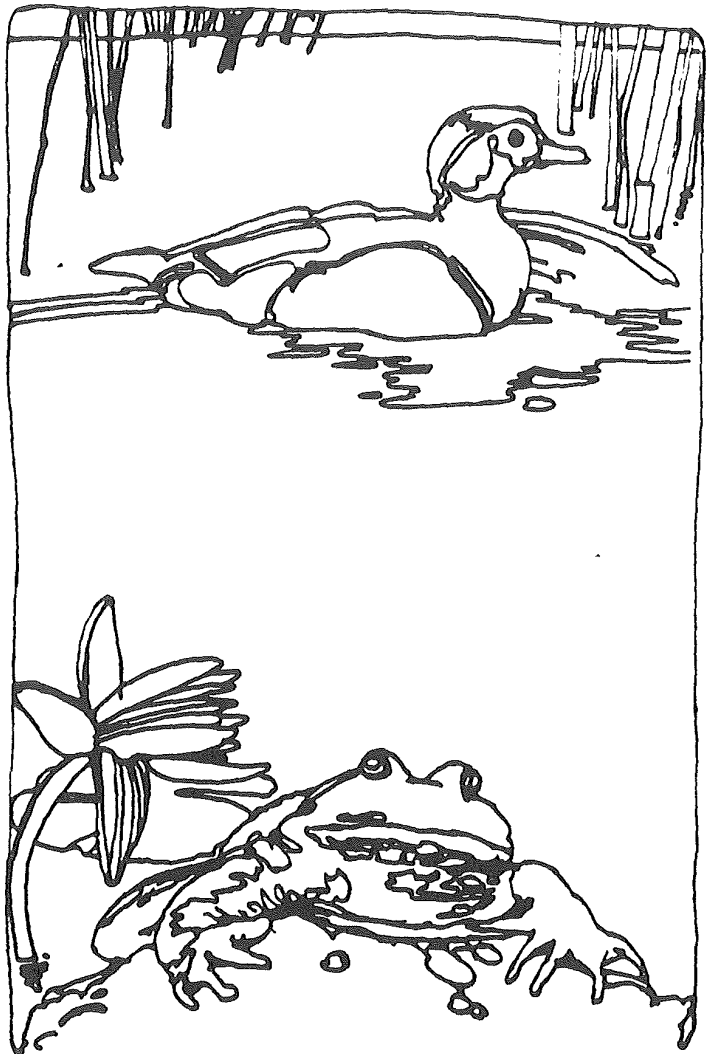


chlordane, dieldrin, and p.c.a.'s, activate enzymes in the liver which transform estrogen into a more water-soluble compound that is readily eliminated from the bird's body. This means that when estrogen levels are low, calcium reserves will also be low, and therefore very little calcium will be available for strong eggshell production. Dieldrin and p.c.a.'s are more effective than DDT in this type of enzyme-induction activity. Aroclor 1262 has an estradiol degrading potential four to five times that of *p,p'*-DDT or technical grade DDT.

The ability of the female bird to deliver calcium to her oviduct during the last 20 hours, when the eggshell is being formed, is related to the functioning of the enzyme carbonic anhydrase. When birds that have exhibited the ability to lay normal eggs are injected with a metabolite of DDT (DDP) just prior to the formation of the eggshell, they will lay thin-shelled eggs. This indicates that DDT also inhibits the activity of carbonic anhydrase, the enzyme that controls the flow of calcium from the blood stream of the bird into its oviduct.

Since dieldrin seems to have no effect on carbonic anhydrase, we may assume that neither do the p.c.a.'s. However, these compounds delay breeding time significantly. Many ornithologists feel that late breeding has a stronger influence on the reduction of bird populations than does the laying of thin-shelled eggs. If this is true, p.c.a.'s are a more potent threat than DDT to our declining bird populations, especially for predatory birds that accumulate fairly high levels of p.c.a.'s because they eat smaller animals that already have concentrated p.c.a.'s in their own tissues.

Other investigators have produced evidence to show that p.c.a.'s are similar to DDT in their activity. Dr. Joseph Street at Utah State University has shown that when p.c.a.'s accumulate in the liver, they induce microsomal enzyme activity by bringing about more rapid metabolism of drugs, insecticides, and other foreign compounds. He fed rats a diet containing 50 p.p.m. of Aroclor 1254 or Aroclor 1260. After 10 days on this diet, the test animals were administered hexobarbital at a dose of 100 p.p.m. to induce sleep. In comparison with a control group, the sleeping time for these rats was reduced by 65 to 80%. Street also found that Aroclor, when fed at the



same level, will reduce dieldrin storage in adipose tissue by 90 to 95%; increase aniline oxidation by 200 to 300%; and increase *SPW* detoxication by 430 to 470%. In addition, the p.c.a.'s cause activation of organothiophosphate compounds, which adversely affect the system. This latter effect counterbalances the detoxification of dieldrin.

Normally, when a substrate activates an enzyme, it is converted to a water-soluble form that will be eliminated from the system; however, this is not the case with p.c.a.'s. Because they remain in the system for prolonged periods of time, their enzyme induction activity is always present. In this way the normal concentration of important body chemicals may be lowered to the

point of bringing about malfunctions in the system. For example, Street believes that the p.c.a.'s bring about steroid degradation, which can lead to altered endocrine relationships.

The chronic toxicity to man is as follows:

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 it is liable to be. Oxides of chlorinated diphenyls are more

toxic than the unoxidized materials.

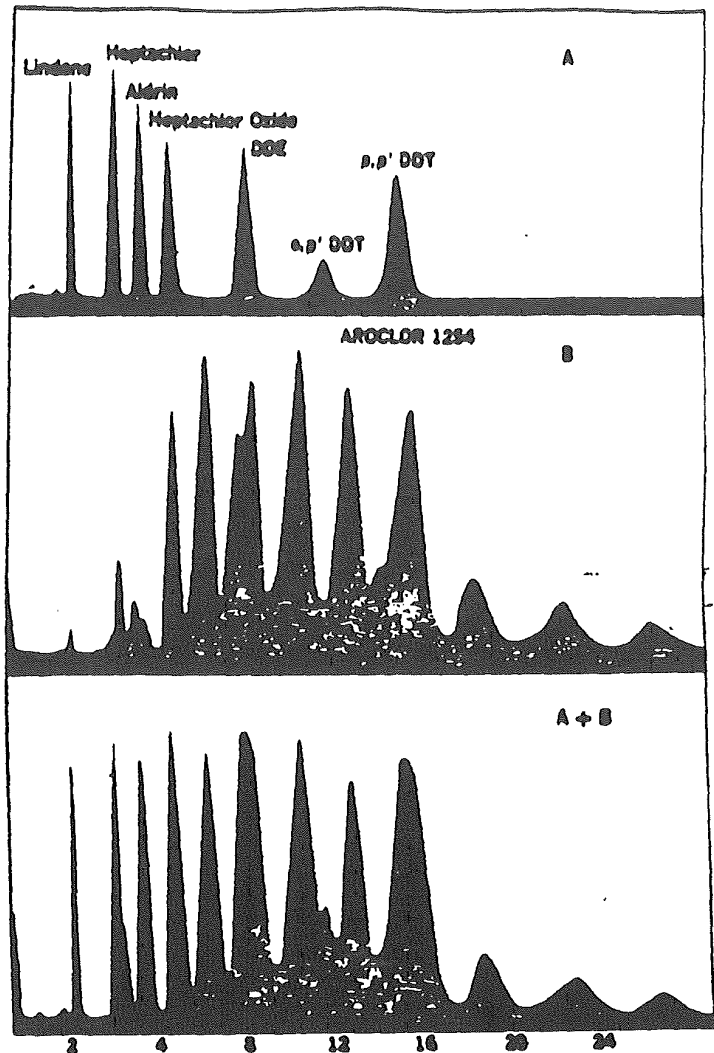
The skin lesion is known as chloracne, and consists of small pimples and dark pigmentation of the exposed areas, initially. Later, comedones and pustules develop. In persons who have suffered systemic intoxication, the usual signs and symptoms are nausea, vomiting, loss of weight, jaundice, edema, and abdominal pain. Where the liver damage has been severe, the patient may pass into coma and die.

Sax, N. Irving, "Dangerous Properties of Industrial Materials," 3rd ed., Van Nostrand-Reinhold, New York, 1968.

The ubiquity of PCB's is related to the wide spectrum of applications that have been found for them. The largest single use of PCB's is related to their electrical properties—as coolant-insulation fluids in transformers. For this purpose the Aroclors are also sold under such trade names as Chlorestol (Allis-Chalmers Mfg. Co.), Dykanol (Federal Pacific Electric Co.), Inerleen (Westinghouse Electric Co.), No-flamint (Wagner Electric Co.), Pyranol (General Electric Co.), and Therminol (Monsanto Co.).

Other uses of PCB's include formulation into ballasts for fluorescent fixtures; impregnation of cotton and asbestos for braided insulation of electrical wiring; a plasticizer in wire and cable coatings; capacitors and askarel-type transformers; and plasticizers of vinyl chloride polymer films. Because of their thermal stability and fire resistance, the PCB's also find application in high-pressure hydraulic fluids, specialized lubricants and gasket sealers, heat transfer agents, and machine tool cutting oils. Miscellaneous uses include: formulation into some epoxy paints; protective coatings for wood, metal, and concrete; adhesives; and in carbonless reproducing paper. One of the primary manufacturers of carbonless reproducing paper also sells Aroclors in an encapsulated form.

Generally the kinds of applications described above mean that the PCB's will be in many types of products that eventually find their way to the domestic market. When used in manufacture of ballasts for fluorescent fixtures they will be found in kitchens, bathrooms, stores, and offices throughout the country. Wherever office forms are used that do not use carbon paper, one may find PCB's formulated into the microcapsules of dye that comprise the re-



Gas chromatogram A is of a standard pesticide mixture, B is typical of Aroclor 1254, and A + B is the chromatogram of a 50 : 50 mixture of both. The concentration of Aroclor 1254 is approximately 10 times those of the pesticides in A, hence it is understandable why PCB's were not readily recognized in pesticide chromatograms. Gas chromatograph (Packard 7620) conditions: gas flow 80 ml./min, nitrogen; temperatures—oven, 210° C., inlet, 230° C., detector, 218° C.; Ni⁶³ electron capture detector; 8' x 1/8" glass column packed with 8% SE-30 on Chromosorb Q 80-80 mesh.

producing layer of the business form. PCB's have also been found on the transparent receipts used in credit card charge forms. As plasticizers they can be expected to appear in many consumer plastics.

Since the chronic toxicities are so significant, it becomes important to know just how extensively the PCB's are distributed in the ecosystem, and just how they find their way into

the environment. Rainwater in England, brown seals off the coast of Scotland, white-tailed eagles in Sweden, cod in the Baltic Sea, mussels in The Netherlands, adelia penguin eggs in the Antarctica, brown pelican eggs in Panama, Arctic terns, shrimp in Florida, river water in Japan, waters in the Great Lakes, human hair, and human adipose tissue—samples of all these have been found to contain PCB's.

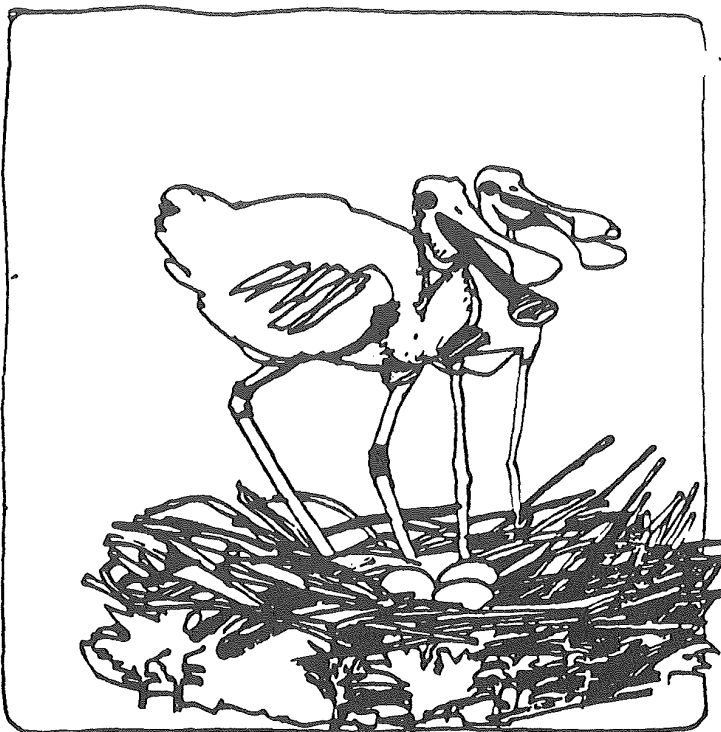
thus making them a class of widely dispersed pollutants.

Readily absorbed

The properties of PCB's that make them industrially useful are the same properties that cause them to persist in the environment. These include thermal stability, resistance to oxidation and hydrolysis, solubility in a wide range of organic solvents, water insolubility, high dielectric constant, and compatibility with many types of macromolecules. Their resistance to oxidation and hydrolysis also makes PCB's more stable and persistent than DDT. Consequently, they could eventually accumulate to a higher concentration than DDT, especially if the use of DDT is sharply curtailed in the U.S.

The solubility of PCB's in nonpolar solvents explains why they are readily absorbed into fatty tissue and into the liver. Their resistance to oxidation or other types of chemical degradation explains their persistence in the environment and accumulation in animal tissue. The latter effect is enhanced both by their insolubility in water and solubility in organic solvents. Their chemical inertness and resistance to metabolism account for their low acute toxicity. But as they slowly build up in a living system their concentration approaches toxicity levels, at which point chronic effects make themselves evident.

It has been established that fish-eating birds will accumulate large concentrations of PCB's, as in the case of the white-tailed eagle, which has been found to have as much as 14,000 p.p.m. of PCB's. Peregrine falcons, taken off the coast of California, were found to have as much as 2000 p.p.m. in their lipid tissue. When shrimp were exposed to 10 p.p.b. of Aroclor 1254 for 48 hours, they accumulated 1300 p.p.b. of PCB's, which represents a 130-fold concentration in a very short time. Oysters, exposed to an identical concentration of Aroclor 1254 for 96 hours and then placed in PCB-free water for four days, still had a concentration of 33,000 p.p.b. of PCB's, which constitutes a 3300-fold concentration. This means that even though the concentrations of PCB's are in the parts-per-billion range in the environment, their high lipid solubility causes them to collect in fatty tissues of lower animals and marine life. Therefore, species at the top of a food chain will also accumulate PCB's in their bodies, particularly in their lipid tissue and liver, in much the same



way as they accumulate DDT and other chlorinated pesticides.

Because of the low solubility of PCB's in water, when a solution or dispersion of them is discharged into a river or lake, they will accumulate on the sediment in relatively high concentrations. Subsequently, they will redissolve very slowly in the water as conditions change. Therefore, it will usually take a long time to flush out a contaminated area.

Accidental occurrence

The reason that PCB's have not been found in the ecosystem as extensively as DDT, and are not present in environmental samples at as high a concentration as DDT, is that PCB's find their way into the environment accidentally. DDT is deliberately spread because this is the only way its insecticidal properties can be utilized. PCB's are not intended to get into the environment, but they do because their unique chemical properties prevent them from being destroyed by our usual waste disposal methods. Thus, they inadvertently escape and become widely dispersed.

In Sweden, where the use of DDT has been banned, and where the main power source is hydroelectric, lavasti-

gation find that the concentration of PCB's in the environment is as high as that of DDT.

There are several ways by which PCB's get into the ecosystem. One of these is by incineration. Products containing PCB's, such as carbonless reproducing paper in business forms, plastics (especially polymer film and sheeting that contain PCB's as plasticizers), spent ballasts from fluorescent light fixtures, and objects coated with PCB-formulated coatings, all find their way to the city dump or incinerator for burning. The PCB's do not burn but are vaporized. They are then carried into the atmosphere, where they collect on particulate matter and are subsequently returned to the surface of the earth, into the rivers, lakes, and oceans. In this way they become widely distributed throughout the global environment. Another source is probably land run-off from industrial wastes and dumps. A third source is the point of manufacture and the plants where PCB's are processed into other products. They can escape through the plant ventilation and exhaust systems into the atmosphere and through its waste treatment system into sewers or directly into waterways.

It is interesting to note that the incidence of PCB's in environmental samples is highest in industrialized and urbanized areas. Birds whose primary habitat is the San Francisco Bay area have a larger concentration of PCB's per unit of body weight than those located in Baja, Calif., which is completely rural. Aquatic life in the Archipelago of Stockholm, the most industrialized area of Sweden, were found to have a higher concentration of PCB's than fish samples taken from the western coast of Sweden, a less developed area. Sediment samples taken from southern portions of Lake Michigan have a higher concentration of PCB's than those from other parts of the lake.

Monsanto states that until a recent change in marketing policy (see inset, page 814), sales of Aroclors were increasing at the rate of 8% per year. While this increase does not seem significant, it may be important if the increased consumption was in consumer products and thus would find their way into our normal solid waste disposal systems. Such an occurrence would mean a definite increase of PCB residues in the environment, and therefore a marked increase in their chronic toxicity effects.

Detection

PCB's were not discovered in environmental samples until very recently for several reasons. First, as indicated above, they have not been deliberately distributed about the ecosystem. Secondly, because of their relatively low acute toxicities, their presence was not immediately evident. Finally, they are difficult to detect analytically.

The PCB's were first detected as interfering peaks in the gas chromatographic analysis (GC) of environmental samples being analyzed for chlorinated pesticide residues. When PCB's are present in a sample they give a pattern of several GC peaks, whose retention times are similar to those of dieldrin, DDT, DDE, aldrin, and heptachlor oxide. Because the peaks were not large or sharp, investigators tended to ignore them until S. Jenasa, in Sweden, and R. Riebsaugh, at the University of California at Berkeley, identified them as corresponding to common constituents of environmental samples being analyzed for persistent pesticides.

The problem of the interference of PCB's with the analysis of other chlorinated pesticides has been largely overcome by prior treatment of the sample. Several investigators have used

column chromatography to separate PCB's from chlorinated pesticides. At a recent meeting, sponsored by the FWQA's National Water Quality Laboratory, Duluth, Minn., a general procedure was recommended for separation of PCB's from pesticides. In this procedure for bioanalysis, the sample is extracted with hexane as in regular pesticide analysis. It is then partitioned with acetonitrile to remove fats, the cleaned-up extract is passed through a Fluorasil column and then through a silicic acid column. Finally, the sample is analyzed by gas chromatography, with a chloride-specific detector. In this way the pesticides are retained on the silicic acid column for later elution and identification.

Research needs

To assess fully the significance of PCB's as environmental pollutants, additional research is needed. No one really knows the extent of the chronic effects of these chlorinated hydrocarbons. Some problems that need to be considered are:

- Although PCB's are known to accumulate in human organs we do not know at what concentration they will begin to exhibit toxic effects. Will these chronic effects be similar to those shown in animals—microsomal enzyme activity, calcium metabolism inhibition, and so on? What are other possible chronic effects?

- Which of the many PCB compounds in the commercially available mixtures are responsible for their toxicity? Can commercial PCB mixtures be modified to eliminate the toxic components? Pure samples are required to answer these questions. At the present time work is continuing at the FWQA's Southeast Water Laboratory to separate each of the Aroclor mixtures into its many components, and to identify each component.

- We need to know all the uses for the PCB's. What is the annual production of PCB's? Our knowledge of these facts is limited and needs to be expanded. These facts should be known if we are to accurately determine how they get into the environment, and take steps to prevent further environmental contamination by them.

- In view of the complexity of the isolation and accurate quantitative analysis of PCB's in chlorinated residues, a straightforward, unambiguous measurement of them needs to be developed.

- What is the fate of PCB's in natural waters? More needs to be known of their partition coefficients between bottom sediments and water. This is vital if we are to estimate how long it will take for a river bed to clean itself of contamination. It will also be useful when assessing the effects of PCB's on marine life that feed on the bottoms of lakes, rivers, and estuaries. We should also learn more about PCB solubility in water of various ionic strengths.

- Are present waste treatment systems adequate to handle PCB's? Do special measures need to be taken when PCB's are part of the waste effluent being treated?

By trying to get some of these answers now, we may find that we are in a position to control the escape of PCB's into the environment before additional damage is done. So frequently, action is taken only after it is evident that massive damage has resulted from a particular pollutant. In the case of the PCB's we may have an opportunity to resolve the situation before that happens.

Additional Reading

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 Reynolds, L. M., *Bull. Environ. Contam. Toxicol.* 4, 128 (1969).
 Riebsaugh, R. N., et al., *Nature* 220 (1968).



Carl G. Gustafson, chairman of the Department of Chemistry of Kings College, Briarcliff Manor, N.Y., received a Ph.D. in organic chemistry from the University of Delaware in 1937. During the 1969-70 academic year, he was on leave at the FWQA Southeast Water Laboratory in Athens, Ga., where he studied trace organic analysis in waste effluents. As a member of the National Water Contaminants Characterization Research Program, he worked with PCB's and pulp and paper mill effluents.