ORIGINAL

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
CIVIL ACTION NO. 86-CI-1566
DIVISION II

COMMONWEALTH OF KENTUCKY, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET — PLAINTIFF

v.

ROCKWELL INTERNATIONAL CORPORATION, TIM SHOOK AND RICHARD L. MONTGOMERY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
LOGAN CIRCUIT COURT
NO. 93-CI-00158

DONALD S. HOUCHENS, ET AL. — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD H. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
LOGAN CIRCUIT COURT
NO. 93-CI-00159

ROGER DALE BARNES and WILDA MAE BARNES — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD H. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
BUTLER CIRCUIT COURT
CIVIL ACTION NO. 93-CI-00119

HOBERT TRACY BELILES, ET AL. — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD E. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

DEPOSITION OF WILLIAM B. PAPAGEORGE, P.E.

Taken on behalf of Defendant Rockwell International Corp.
September 23, 1993

INDEX OF EXAMINERS

INDEX OF EXHIBITS MARKED AND/OR REFERENCED

COMMONWEALTH OF KENTUCKY
FRANKLIN CIRCUIT COURT
CIVIL ACTION NO. 86-CI-1566
DIVISION II

COMMONWEALTH OF KENTUCKY, NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET — PLAINTIFF

v.

ROCKWELL INTERNATIONAL CORPORATION, TIM SHOOK AND RICHARD L. MONTGOMERY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
LOGAN CIRCUIT COURT
NO. 93-CI-00158

DONALD S. HOUCHENS, ET AL. — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD H. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
LOGAN CIRCUIT COURT
NO. 93-CI-00159

ROGER DALE BARNES and WILDA MAE BARNES — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD H. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

COMMONWEALTH OF KENTUCKY
BUTLER CIRCUIT COURT
CIVIL ACTION NO. 93-CI-00119

HOBERT TRACY BELILES, ET AL. — PLAINTIFFS

v.

ROCKWELL INTERNATIONAL CORPORATION, RICHARD E. RAMPON, JOHN McCLURE KERR and DAVID R. STANLEY — DEFENDANTS

DEPOSITION OF WILLIAM B. PAPAGEORGE, P.E., produced, sworn and examined on September 23, 1993, on behalf of Defendant Rockwell International Corp., between the hours of eight o'clock in the forenoon and eight o'clock in the afternoon of that day, at the Marriott Hotel, Highway I-70 at Lambert International Airport, St.

Louis, Missouri, before TAMI L. BRUDER, a Registered Professional Reporter and a Notary Public within and for the State of Missouri.

A P P E A R A N C E S

For the Plaintiffs (telephonically):

Charles L. Cunningham, Esquire
304 West Liberty Street, Suite 200
Louisville, Kentucky 40202

For the Defendant Rockwell International Corporation (telephonically):

J. Anthony Goebel, Esquire
WYATT, TARRANT & COMBS
Citizens Plaza
Louisville, Kentucky 40202

For the Defendants Tim Shook and Richard L. Montgomery (telephonically):

Gregory A. Bolzle, Esquire
WOODWARD, HOBSON & FULTON
2500 First National Tower
Louisville, Kentucky 40202

For the Deponent and Monsanto Company:

Gerard H. Davidson, Jr., Esquire
SMITH, HELMS, MULLISS & MOORE
300 North Greene Street, Suite 1400
P.O. Box 21927
Greensboro, North Carolina 27420

IT IS HEREBY STIPULATED AND AGREED by and between Counsel for the Plaintiffs and Counsel for the Defendants, that this deposition may be taken in shorthand by TAMI L. BRUDER, a Notary Public and Registered Professional Reporter, and afterwards transcribed into typewriting and signed by the Witness.

o-O-o

WILLIAM B. PAPAGEORGE, P.E.,

of lawful age, being produced, sworn and examined on the part of the Defendant Rockwell International Corporation, deposes and says:

DIRECT EXAMINATION

QUESTIONS BY MR. GOEBEL:

Q. This is Tony Goebel. I'm going to go ahead and start the questioning, and then I don't know who will go next, but if there are objections, I guess we can agree that we'll just make sure that the witness doesn't interrupt, because on the speaker phone, there might be a little time lag in there, so -- so, Mr. Papageorge, you might give us a little bit of time before to see if there is an objection.

A. I'll try to do that.

Q. Okay.

A. I don't mind being reminded if I don't.
Q. All right.
A. Can you hear me all right?
Q. Yes. We can.
A. Good.
Q. I suppose you can hear us okay?
A. Yes.
Q. Would you state your full name, please?
A. William B. Papageorge.
Q. And what is your current address?
A. 321 Pebble Valley Drive, St. Louis, Missouri 63141.
Q. Would you briefly tell us your educational background, Mr. Papageorge?
A. I received a bachelor of science in chemical engineering degree in 1943 and a master of science in chemical engineering in 1947 from Washington University in St. Louis. In addition to that, I had earned 12 credits toward a doctor of science degree at Oklahoma A & M, currently known as Oklahoma State University.
Q. Over the years, have you attended seminars relating to your field of study?
A. Yes.
Q. And would you generally tell us how many seminars you attended, if you can?

A. Oh, I -- I have never kept a score sheet on them. There were many. And when you say my field of study --

Q. Engineering, chemical engineering.

A. Chemical engineering. Because many of these seminars really became business-oriented types of seminars. As best I can recall, I would suggest that maybe a half a dozen seminars relating to chemical engineering.

Q. And you said that you attended other seminars related to the business in which you have worked. What kinds of seminars were those and how many did you attend?

A. Oh, I -- I attended sessions at Washington University at their school of business administration in the 19 -- early 1960s. I attended seminars at the American Management Association in New York City in the middle to late 1960s. There were others that, at the moment, don't come to mind here.

Q. Have you ever taught any seminars?

A. I have taught seminars -- I hope we have the same definition of seminars. I have taught seminars within Monsanto --

Q. All right.

A. -- Company.

Q. Let's get into your work experience. After

you obtained your master's in chemistry degree, what was the first employment that you had?

A. I was employed by the Phillips Petroleum Company in Bartlesville, Oklahoma.

Q. And for how long did you work there?

A. From 1947 to 1951.

Q. What did you do for Phillips Petroleum?

A. I initially worked in Phillips Petroleum's research department, working with drilling fluids and secondary petroleum recovery. That assignment lasted for about two years, and then I was assigned to the refining department where I did engineering work relating to equipment used by the petroleum industry in separating the different petroleum fractions or materials.

Q. All right. What kinds of -- you mentioned that you had worked with drilling fluids in the research department. What kinds of fluids were those?

A. I don't know how to describe it. They were mixtures of clays with various additives that are used during the oil well drilling process to lubricate the bit and to carry the cuttings back up to the surface, resulting in a clean hole.

Q. All right. In 1951, you changed employers?

A. I did.

Q. Where did you go to work then?

A. I joined the Monsanto Chemical Company.

Q. And what was the first job position you had with Monsanto?

A. I was assigned as a design engineer in the plant's engineering or technical department.

Q. What were your responsibilities in the design engineering department?

A. To specify the equipment required to produce a product at the plant. This included pumps and tanks and distillation columns, instruments and the like.

Q. Would you tell the jury a little bit about the Monsanto Chemical Company, and I would ask you to limit your question to its involvement of the manufacture of PCBs or polychlorinated biphenyls?

A. Well, Monsanto, in 1935, acquired the Swan Chemical Company, and at the Anniston, Alabama plant of that company PCBs were manufactured, and this was Monsanto's first involvement with PCBs. Within a year or two, the plant in Sauget, Illinois, S-a-u-g-e-t, was designated as the second plant within Monsanto to produce PCBs. As best I recall, shortly after World War II, an additional plant was constructed in the United Kingdom at Newport, Wales. In late 1969, Monsanto, in a joint venture with Mitsubishi Chemical Company, built a plant in Japan. Does that help?

Q. Yes. It does.

A. All right.

Q. What kinds of -- when you say Monsanto manufactured PCBs, what kinds of products did -- eventually that Monsanto produced were PCBs put into and what were their uses?

A. The PCBs were used in mixtures of materials that resulted in fluids used in electrical equipment such as transformers, capacitors and starting equipment. The PCBs were also used as an ingredient in fluids used in hydraulic systems, industrial hydraulic systems as distinguished from automotive hydraulic systems. PCBs were also an ingredient in fluids used in industrial heat transfer systems. They were also an ingredient in fluids used in vacuum systems. The PCBs were used as additives in such things as paints and coatings, caulking materials, adhesives, inks, carbonless copy paper. I believe I've covered all of the uses that come to mind at the moment.

Q. Was Monsanto the only manufacturer of PCBs in the United States after 1935?

A. It's hard to prove one way or the other that Monsanto was the only or the major. There is some indication that other companies attempted and did make some PCBs through the 40 or so years that PCBs were manufactured. I personally would suggest that the best

word to use describing Monsanto's production is to suggest that it's a very high, 90 plus percent.

Q. All right. We've talked about PCBs. What are PCBs and why would they be desirable for use in like a hydraulic fluid?

A. PCBs are the -- let me back -- let me start over again. The acronym PCBs is really used to describe the chemical family called polychlorinated biphenyls. These are materials that are made from benzene and chlorine. They number over 200 different members of that family of chemicals. The materials sold for industrial purposes always consisted of various mixtures of these 200 or so different chemical entities. The attractive feature that PCBs had, and still have, they are very stable chemicals that offer the highly desirable characteristic of being fire resistant. So, relating to the use in hydraulic fluids, the benefit is one of being able to have a fluid under a high pressure in a situation where fires can and do result, that the fluid, if it should ever escape, would not ignite.

Q. Was there -- at the time PCBs were used in hydraulic fluids, was there any better formulation to -- that would resist fire than PCB-containing fluids that you know of?

A. I don't personally know of any better

formulation as it relates to the properties of the material, including lubricity, stability, fire resistance, these kinds of things.

Q. In our case we've had the term "Aroclor" come up. What is the relationship between Aroclors and PCBs?

A. Aroclor, that's capital A-r-o-c-l-o-r, is Monsanto's trademark for some of their products. Included in that trademark were the PCBs that were sold as PCBs without any other additives.

Q. And then different Aroclors could have been contained in different formulations of PCB-containing hydraulic fluids; is that right?

A. That is correct.

Q. Let me get back to your work experience with Monsanto Company or Chemical Company. You've told us about being in the design engineering department. How long did you stay there?

A. A couple years.

Q. And then what was your -- did you continue to stay with Monsanto Company after that?

A. Yes.

Q. What was your new position?

A. Following the engineering assignment, I was assigned as a -- at first as an assistant supervisor and finally as a supervisor in two units of the plant that

produced chemicals.

Q. And in what year did you make a move to a plant?

A. Well, from the very beginning, the -- for example, the engineering department that I joined was a part of a Monsanto plant, so I moved really from the engineering department into the production department.

Q. In which plant was the design engineering department located?

A. It's the Monsanto plant located in St. Louis referred to by Monsanto as the J.F. Queeny Plant.

Q. And how long were you at the J.F. Queeny Plant?

A. Until 1964.

Q. And then you were transferred to another plant?

A. I was.

Q. Which plant is that?

A. I was transferred to the Sauget, Illinois plant.

Q. And that, from your earlier testimony, is one of the plants that produced products which contained PCBs?

A. That is correct.

Q. What was your position at the Sauget, Illinois plant?

A. I was one of five or six general superintendents of production.

Q. And what were your responsibilities as a general superintendent of production?

A. I was assigned several operating units that produced, as best I remember, something like 20 or so different chemical products.

Q. And did those chemical products contain PCBs?

A. No.

Q. So, when you were at the Sauget, Illinois plant, you didn't work with any products that contained PCBs; is that right?

A. I hesitate because in producing the products assigned to me, some of the units used PCBs in their systems such as their air compressors or their heat transfer systems or the transformers, so PCBs were involved but not as a product.

Q. Is that when you first became familiar with PCBs and their use?

A. No.

Q. When did you first become familiar with PCBs?

A. About 1956 or so.

Q. And that was when you were in the design engineering department?

A. No. That's when I was assigned to the plant

maintenance and construction department.

Q. And in what sense did you become familiar with PCBs in 1956?

A. I was a supervisor of a team of craftsmen who were involved in the installation of new equipment, not under -- not with major projects, but with small projects throughout the plant, and in supervising that work force, I had to become familiar with the materials they might be involved with, and when this group would install, say, a transformer or replace a pump in a heat transfer system or install a compressor and fill it with hydraulic fluid, that's when they became involved with PCB-containing fluids.

Q. Between 1956 and during the time you were at the Sauget, Illinois plant, what other experiences did you have with PCBs or PCB-containing fluids?

A. The involvement with PCBs and employees broadened when I was appointed superintendent of the maintenance department in about 1958 or so. This included not only that small new construction work force but all of the plant's craftsmen, which numbered about 400 or so, involved in many ways with PCB-containing materials. In 1963, I was assigned as general superintendent of warehousing distribution and utilities. During that assignment, I was involved with PCBs in at least two ways,

one as a shipper of the material from the warehouse or the tank farms, the other was as the use of PCBs in the utilities department which was involved with the distribution of electrical power in the plant. I think that brings me up to the assignment at the Sauget, Illinois plant.

Q. Did you leave the Sauget, Illinois plant after 1965?

A. I did.

Q. In what year?

A. 1965. I forget the exact month, but --

Q. And where were you transferred to?

A. I was transferred to Anniston, Alabama, at Monsanto's plant located there.

Q. You told us earlier that that plant also manufactured PCB-containing fluids --

A. That is correct.

Q. -- or products containing PCBs?

A. Yes.

Q. What was your position at the Anniston, Alabama plant?

A. I was plant manager.

Q. And as plant manager, what were your responsibilities?

A. I guess I was best described -- I was

responsible for everything that happened at the plant or to the plant.

Q. What products did Monsanto manufacture at Anniston, Alabama?

A. Of course, we had the PCBs. There was also a group of chemicals referred to as polychlorinated terphenyls, t-e-r-p-h-e-n-y-l-s, biphenyl, chlorine, hydrochloric acid, phosphorus pentasulfide and an insecticide we called Parathion, P-a-r-a-t-h-i-o-n, and another pesticide we called Niran, N-i-r-a-n.

Q. Did you use different Aroclors in the manufacture of these products you just mentioned?

A. These two, the pesticides?

Q. No. All of them. Well, I guess it would be in the polychlorinated biphenyl products that you would have used several different kinds of Aroclors; is that right?

A. That is correct.

Q. And could you tell me the different kinds of Aroclors used?

A. At that time at the plant, the Aroclors that were used to make products shipped from the plant that included other materials would be Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260.

Q. Would you explain in a non-technical way the

difference between, for instance, an Aroclor 1242 and, let's say, 1260?

A. Well, they're, of course, a -- one difference is the type of PCB in the final mixture, but the predominant feature really is one of the amount of chlorine in that total mixture. The 42 used in the terminology represents 42 percent by weight of the material is chlorine. The 60 used in the Aroclor 1260 designation refers to the presence of 60 percent of the material by weight being chlorine.

Q. All right.

A. So, the higher the last two digits, the more chlorine is present.

Q. In the manufacturing process at the Anniston, Alabama plant, I suppose you would have waste waters that would contain PCB fluids or PCBs?

A. Yes. Yes, on occasion.

Q. And what years were you at the Anniston, Alabama plant?

A. From fairly early in '65 to the end of '69.

Q. How did Monsanto dispose of its waste waters that contained PCBs at that plant?

A. The waters that could possibly on occasion contain PCBs were sent to an in-plant pond, one of two ponds. In this pond there was crushed rock which was

there to neutralize any acid that might be present in that water. Remember, I said earlier about the presence of hydrochloric acid at the plant. The pond also served as a -- I'm going to call it a trap, if you will, to capture any PCBs that might have gotten into that water. That water then, after settling for -- I forget the exact number of days or retention time in that pond, would flow to the Anniston, Alabama waste water or municipal treatment plant. Frequently, and I have forgotten the degree of frequency, the pond would be bulldozed, if you will, to pick up the sediment, the crushed rock that was contaminated with PCBs, and that material would be drummed and hauled off to the in-plant landfill. The pond would then be re-lined with the proper clays to prevent water from seeping through. New crushed rock would be applied and the pond would be ready for service. In the meantime, the second pond was in service, so they would alternate the two ponds.

Q. If I understand your testimony correctly, you said that once the water -- the waste water would sit in the pond a while, then you would -- would you actually treat the water before it was deposited into the Anniston, Alabama waste treatment facility or would it just be skimmed off and put there?

A. I think the skimmed off applies better. The

water or the sediment at the bottom would be retained. It's the clear water on top that would be pumped to the municipal treatment plant.

Q. And as plant manager, did you think that this was an acceptable means of disposing of Monsanto's waste waters at the time?

A. Yes, sir.

Q. You left there in 1970, I believe, the Anniston plant?

A. Yes, sir.

Q. Do you know how long after 1970 that the Anniston plant continued to put its waste waters in a holding pond?

A. Are we talking here now as it related to PCBs?

Q. Yes.

A. As I recall, the production of PCBs at Anniston was terminated in 1972, so the pond would no longer be involved with PCBs.

Q. Only because they stopped manufacturing PCBs in 1972?

A. At that plant, yes, sir.

Q. After you left the Anniston, Alabama plant, what was your next position with Monsanto?

A. I was assigned to work in the St. Louis

offices of Monsanto with the title of manager, environmental control, involved with the PCB in the environment issue that was evolving at the time.

Q. Was that a new position or did you replace someone?

A. That is a new -- that was a new position.

Q. All right.

MR. BOLZLE: What year was that again?

MR. GOEBEL: 1970.

Q. (By Mr. Goebel) When you say involved with the PCB issue evolving at the time, what were your responsibilities as manager of environmental control as related to the PCB issue evolving?

A. The responsibilities involved really the PCBs and their presence in the environment, the possible effects on the environment, and it was my responsibility to try to keep abreast of all the rapidly developing information and sharing this with, of course, people within Monsanto involved with PCBs and also with customers as well as regulatory representatives and various private laboratories and, of course, including laboratories at several universities.

Q. When you say that you tried to keep abreast of all information, did you read a lot about the studies that were being conducted during that time period?

A. Yes, sir, as much as I was made aware of, could find.

Q. Did Monsanto do its own studies at the time or did it conduct its own studies?

A. Yes. It did.

Q. And were you also made aware of what those studies were?

A. Certainly.

Q. And how were you involved other than just reading about them?

A. About which? The Monsanto studies?

Q. Yes.

A. Oh, I, of course, in many ways looked over the shoulder of the researchers in Monsanto. I was privileged to attend the contract laboratories conducting animal testing studies. I sat in on many meetings at which the progress of these studies was reported. I helped to get proper financing of some of the work. I don't know what else to share with you here. I tried to get as involved as I could.

Q. All right. When you said that you looked at the presence of PCBs in the environment, would it also be true that you were familiar with the studies around that time period in the 1970s on the impact of PCBs on the environment and the alleged health hazards of PCBs?

A. I certainly tried to do so. Yes.

Q. Are you familiar with the Swedish study?

A. Yes.

Q. And for the jury, would you tell us what the Swedish study was?

A. At the University of Stockholm, there were two principal investigators, Drs. Widmark and Jenssen, J-e-n-s-s-e-n, who were conducting studies to determine the presence of DDT in the environment. As they were conducting these studies, they kept running into an interference in their instruments and in their results. They weren't initially sure of just what this material was. They finally speculated or believed that it was PCBs. They reported this, as I recall, in late 1966 at a meeting in Europe, and it was about 1967 that they were pretty well convinced that it was PCBs that were causing these interferences. That was the gist of it.

Q. All right. Did -- so, really, the Swedish study, based on their study, they detected the presence of PCBs in the environment in Europe, right?

A. In samples obtained near their university, yes, sir. I don't know that -- correctly to say in total, in all of Europe, no, at that time.

Q. And did they do -- other than to indicate that PCBs were present in the environment in the location

that you just described, did the Swedish study involve an analysis of the impact of PCBs on the environment or on human health?

A. No.

Q. Did the researchers who conducted the Swedish study, were they able to narrow the kinds of PCBs that they found in the environment?

A. Yes. They were. They were reporting the presence in environmental samples of the higher chlorinated types of PCBs.

Q. And I believe they discovered the PCBs that had 54 percent or 60 percent chlorine by weight; is that right?

A. That is correct.

Q. Have you had a chance to review the Monsanto records on the kinds of Pydraul used at the Rockwell Manufacturing, Russellville, Kentucky plant?

A. Yes. I have.

Q. And based on those records, I believe the Russellville plant used Pydrauls 312 and F-9; is that right?

A. That's what I saw in the record. Yes, sir.

Q. And I believe -- well, can you tell me, first of all, what is Pydraul?

MR. DAVIDSON: Tony, this is Gerard. May I

interrupt a minute? Bill, if it would be possible, would like to take a short break.

MR. GOEBEL: Oh, sure.

MR. DAVIDSON: And I'll run down and see if the faxes are here yet.

MR. GOEBEL: Why don't you just give us a call back when you're ready and they'll put you through here?

MR. DAVIDSON: Okay.

[Short break was taken.]

[Reporter marked Defendant's Exhibits 1 through 5.]

MR. GOEBEL: Court reporter, I think I asked him -- the last question was about Pydraul. I can't remember exactly what it was.

[Reporter read from the record as directed.]

Q. (By Mr. Goebel) That's the pending question. Can you tell me what is Pydraul?

A. Pydraul is a Monsanto trademark used by Monsanto on its fluids sold for use in industrial hydraulic systems.

Q. And Pydraul 312 and F-9 would have been two different formulations of fluids, right?

A. That is correct.

Q. Do you recall the Aroclors contained in Pydrauls 312 and F-9?

A. As best as I can recall, the F-9 contained Aroclor 1248 and the Pydraul 312 contained Aroclor 1242 and Aroclor 1248.

Q. I know that Monsanto's records do not reflect that they had shipped Pydraul A-200, but I believe the evidence in this case is that A-200 was used at Russellville. Assuming that as true, do you know what Aroclors were used in the Pydraul formulation A-200?

A. As best as I can recall, it's Aroclor 1242.

Q. All right. Do the Monsanto records reflect that the Russellville plant used any Pydrauls other than those we've already discussed?

A. We've discussed three of them, the F-9, the 312 and the A-200.

Q. And I guess I should say any PCB-containing Pydraul fluids other than those?

A. I saw nothing that would indicate that other PCBs were involved at that location.

MR. DAVIDSON: I would like to clarify. I think that he -- Bill testified at the beginning of your questioning about this, that the records reflected -- that Monsanto's records reflected sales of Pydraul F-9 and Pydraul 312 to the Russellville plant, but not Pydraul A-200.

MR. GOEBEL: Right.

Q. (By Mr. Goebel) Other than those Pydrauls, 312 and F-9, it's my understanding that Monsanto's records do not reflect that Russellville used any other fluids; is that right?

A. That is correct.

Q. That is, PCB-containing fluids?

A. That is correct.

Q. So, none of the fluids used at Russellville would have contained Aroclors 1254 or 1260; is that right?

A. That is correct.

Q. After you became familiar with the Swedish study and the results and the conclusions they had reached there, did you send out a letter to Monsanto customers about the presence of the Aroclors or the higher chlorinated PCBs?

A. When you say you, you mean me personally or Monsanto?

Q. Monsanto.

A. Monsanto. There was a mailing in March of 1969 that referred to the Swedish studies along with some other studies known at that time. A similar letter was sent in early February of 1970.

Q. And I believe we have a copy of the February 9th, 1970 letter, and I'll ask the court reporter to please mark it as Exhibit 1 and hand it to you and see if

that is the letter to which you just referred?

A. I have the exhibit and it is a copy of that letter.

Q. In the second paragraph of that letter -- well, why don't you generally identify the letter? Tell me generally what it is, what it purports to be.

A. It's a letter with Monsanto letterhead dated February 9, 1970, authored by Donald A. Olson, director of sales, functional fluids group. It's addressed to Dear Sir and attached to that letter is a copy of an article from the journal Chemical Week dated October 29, 1969.

Q. And it says that the letter was being written in response to several newspaper and magazine articles published about PCBs discovered in marine, aquatic and wildlife environments; is that right?

A. It does.

Q. And in the second paragraph of that letter it states that the PCBs found resembled the higher chlorinated biphenyls, that is, the 54 percent and 60 percent chlorine by weight?

A. It does.

Q. And that would be, in Monsanto's tradenames, the Aroclors 1254 and 1260; is that right?

A. That is correct.

Q. But you just told us that the Russellville

plant had not used any fluids that contained these higher chlorinated PCBs, right?

A. Not to my knowledge. That is correct.

Q. Further down on page one of Exhibit 1 it says, "We would like to point out the following additional facts, number one, products such as" -- and then it lists several different Pydrauls, which include 312 and F-9, "are not formulated with Aroclor 1254 or 1260." That is a true statement, isn't it?

A. That is correct.

Q. And then point number two at the bottom of the page says that PCBs with chlorine content of less than 54 percent have not been found in the environment and appear to present no potential problem to the environment? Is that what it says?

A. It does.

Q. Was that statement true at the time that it was made?

A. It was.

Q. All right. And PCBs with chlorine content of less than 54 percent would have included the Pydrauls 312 and F-9; is that right?

A. That is correct.

Q. Let me show you Exhibit No. 2 which is a form letter from Monsanto authored by a Mr. Schalk. Do you

have that?

A. I do.

Q. Is that the other letter to which you referred a moment ago?

A. No. This is a letter that was also sent out in February of 1970 to customers of Monsanto's PCBs used in various applications which Monsanto referred to as plasticizer applications. This included paints and coatings, sealants, caulking, adhesives, inks and so on.

Q. But the letter sent out in, I think you said, March of '69, would that have been along the same lines as Exhibits 1 and 2?

A. Yes, sir.

Q. All right. Exhibit 2 is very similar, is it not, to the language in Exhibit 1 in that it refers to several newspaper articles and magazines articles published about PCBs and their discovery in some marine, aquatic and wildlife environments?

A. That is correct.

Q. Then paragraph two of Exhibit 2 also identifies PCBs found in the environment as being the higher chlorinated biphenyls, that is, those containing 54 percent and 60 percent chlorine by weight; is that right?

A. That is correct.

Q. And again, in the -- at the bottom of Exhibit

2 it says that those PCBs with less than 54 percent have not been found in the environment and appear to present no potential problem to the environment; is that right?

A. That is correct.

Q. And that would include the Pydrauls used at the Russellville facility? They contained less than 54 percent of chlorine by weight?

A. Yes, sir.

Q. Let's move on to Exhibit No. 3. It's a letter dated January 31, 1972. Do you have that in front of you?

A. I do.

Q. The subject of this letter is polychlorinated terphenyls, and you have mentioned that term before. Would you tell the jury what a polychlorinated terphenyl is, please?

A. I'll try. Let me compare it to the PCBs. PCBs have two phenyl groups, and by phenyl I'm talking about the equivalent of the benzene ring, the hexagon diagram used by the chemist to graphically show benzene. The terphenyls have three of these benzene rings in their makeup. Does that help, sir?

Q. Yes. At the time that you were in your position as manager of environmental control, were you aware of any studies conducted by Monsanto or anyone else

that indicated that PCBs were in the environment -- or PCTs, I'm sorry, were in the environment?

A. I recall some samples taken by Monsanto representatives and the analytical laboratory looking for PCTs in those samples and none were found.

Q. When I say PCT, that's polychlorinated terphenyls, right?

A. Terphenyls. That's correct.

Q. Are you aware of any studies that PCTs were an environmental hazard?

A. I'm not aware of any such studies.

Q. Did anyone at Monsanto ever conclude that PCBs were an environmental hazard?

A. Did you say PCTs?

Q. Pardon me. PCTs.

A. No. There was no evidence to support that conclusion.

Q. I believe Monsanto's records reflect that this Exhibit 3 was sent to the Russellville plant. Did there come a time when the Pydraul fluids had been switched over from a PCB fluid to a PCT fluid?

A. Some of them were switched over, yes, during 1971.

Q. Do you recall if Pydraul 312 and F-9 were some of those fluids that were switched over to PCTs?

A. They were.

Q. And I'm sorry if you gave me the date. When did that transfer of the new formulations come about?

A. I believe that occurred during '71.

Q. Do you know when specifically in 1971?

A. No. Not to the day or month. No, sir. I'd have to look at the records to refresh my memory.

Q. All right. Would the PCT-containing Pydraul fluids have ever contained an environmental warning label?

A. No. There was no basis for wording any kind of warning.

Q. Referring back to Exhibit No. 3, the letter says in the first paragraph, "We have decided to stop using polychlorinated terphenyls as a component in our fluids. Our new fluids will contain no chlorinated components." What is meant by the term "chlorinated components?"

A. These are chemical ingredients that contain chlorine as part of their makeup.

Q. That would include a lot of different things, right?

A. Oh, yes. There are literally thousands of chlorinated chemicals.

Q. It would include products other than just PCBs; is that right?

A. It's possible. Yes.

Q. Chlorinated components can mean products other than PCB-containing products?

A. Yes.

Q. This letter does not mention PCBs by name, does it?

A. It does not.

Q. And it does not indicate which Pydraul fluids would have contained polychlorinated terphenyls or which ones would have contained PCBs; is that right?

A. No. The letter does not say so, but in 1972, PCBs were no longer used in Pydraul fluids.

Q. And this letter does not contain any mention of environmental problems associated with PCTs or PCBs; is that right?

A. That is correct.

Q. Let's move on to Exhibit No. 4. Mr. Papageorge, this is a letter dated March 15, 1972, correct?

A. It is.

Q. And it starts out by saying, "Confirming our previous letters on Pydraul reformulations," and then it says, "We will begin shipping the new Pydraul products within 30 to 60 days." The last letter that I think that we have is dated January 31, 1972, and that's the one we

just saw; is that right?

A. That is correct.

Q. And that discussed the reformulation with the elimination of the PCTs from the fluids?

A. Yes.

Q. In the attachment it has a conversion from the old product to the new product?

A. It does.

Q. Neither the letter nor the attachment mention PCBs by name, do they?

A. It does not.

Q. It does not designate which formulas of Pydraul would have contained PCBs, PCTs or any other formulation, does it?

A. It does not.

Q. And again, this letter does not mention any alleged environmental harms associated with PCBs; is that right?

A. It does not.

Q. Let's move on to Exhibit No. 5 which is a letter dated August 3rd, 1973.

MR. GOEBEL: I believe, Gerard, I didn't have a complete copy here with me, but I believe he does. Can you give us the Bates stamps of that exhibit?

MR. DAVIDSON: Yes. Exhibit 5 is Bates stamp

070 through 084, and it consists of a two page letter, a one page attachment listing products, a two page letter on Monsanto letterhead entitled Incineration Service For Pydraul Fluids, and the last item, 075 through 084, is a copy of an article from the Federal Register dated July 6, 1973, Volume 38, Number 129, Part II, entitled Polychlorinated Biphenyls, Contamination of Animal Feeds, Foods, and Food Packaging Materials and Availability of Supplement to Environmental Statement on Rulemaking.

MR. GOEBEL: All right. Thank you.

Q. (By Mr. Goebel) Mr. Papageorge, I'd like to refer you to page one of Exhibit 5.

A. I have it.

Q. The first sentence says, "In February, 1971, we announced the reformulation of our Pydraul industrial fluids to eliminate the use of polychlorinated biphenyls, PCBs, as components of these fluids. Since then, we have reviewed our formulation and taken further steps to remove all chlorinated compounds from our Pydraul fluids." Do you see that?

A. I do.

Q. There's a -- there's a distinction there, is there not, between the use of the words polychlorinated biphenyls or PCBs and formulations that contain chlorinated compounds; is there not?

A. Yes.

Q. Those containing chlorinated compounds, would that be the polychlorinated terphenyls that we've discussed?

A. Yes.

Q. After this date, Monsanto went to a phosphate ester formulation of Pydraul; is that right?

A. After which date, sir?

Q. Well, August 3rd, 1973.

A. No. It was prior to that that the use of phosphate esters was introduced.

Q. About what date, approximately, would the Pydrauls containing phosphate esters have been introduced?

A. Well, they were introduced as reflected in the January, 1972 letter and fully implemented as reflected in the March 15, 1972 letter, Exhibits 3 and 4.

Q. So, when those letters, Exhibits 3 and 4, refer to the new formulations, those new formulations would be the phosphate ester formulations?

A. Yes.

Q. The last sentence of the third paragraph, it says that there is a list attached identifying the Pydraul fluids which contain chlorinated ingredients and those which do not. Do you see that?

A. I do.

Q. Then Bates stamp number -- page number 72 is that list; is it not?

A. It is.

Q. The list at the top refers to Pydraul fluids which contain chlorinated ingredients, doesn't it?

A. Yes.

Q. And we already know that that could be PCBs or PCTs or many other different ingredients, right?

A. Well, for the Pydraul fluids, it's limited to PCBs and PCTs.

Q. This letters does not designate which of the Pydraul fluids contained PCBs and which ones contained PCBs or PCTs, does it?

A. No. The letter doesn't do so. No.

Q. Just for our information today, which of the designations -- can you tell which ones would have contained PCBs and which ones would have contained the terphenyls?

A. Yes. I can. For the Pydrauls which are part of our discussion, F-9 and 312, you will note that listed is a 312A and an F-9A. The "A" refers to the polychlorinated terphenyl formulation.

Q. And the designation without any letter is the PCB fluid?

A. Yes. The original formulation contained

PCBs.

Q. As I indicated earlier, there are some records which show that the Russellville plant may have used A-200. There's a -- there are three designations of A-200 on this list?

A. Yes.

Q. The A-200 would be the PCB fluid, correct?

A. Yes.

Q. And the A-200A would be PCT?

A. Yes.

Q. How about A-200B? What is that formulation?

A. It's also a PCT with different ratios of ingredients.

Q. And then the fluids identified at the bottom of that page which do not contain chlorinated ingredients, those would be the phosphate ester fluids?

A. Yes, sir.

Q. They are designated with the letters "E" and "C", correct?

A. Correct.

Q. I want to go back to our discussion about some of the studies that would have been published in the 1970s, late '60s, 1970s, and you've told us about the Swedish study. Are you aware of a study relating to the peregrine falcon?

A. Yes.

Q. Would you explain what the preliminary conclusions were about PCBs as it related to the peregrine falcon?

MR. CUNNINGHAM: Let me object here on the record. I don't recall anything from Mr. Papageorge's background that made him any kind of a toxicologist or biologist or anything, so with that objection noted, I'd love to hear what he has to say.

MR. BOLZLE: I'll make the same objection.

A. There was a study conducted at Cornell University, and the principal investigator was Dr. David Peakall, P-e-a-k-a-l-l, and I recall reading his report in which he found both DDT and PCB in peregrine falcons and concluded that PCBs as well as DDT were both responsible for the inability of the falcon to produce eggs that would result in a proper reproduction of the falcon.

Q. (By Mr. Goebel) Did he make any later conclusions about the cause of this phenomenon to the peregrine falcon?

A. Yes. About a year or so later, it was concluded, not only by Dr. Peakall but also the laboratories of the Department of Interior in Patuxent, Maryland, which is a wildlife laboratory, that the cause for the inability of the falcon to reproduce was due

primarily to the presence -- was due to the presence of DDT.

Q. And not PCBs?

A. Correct.

Q. Let me refer you back to Exhibits 1 and 2. In the first sentences of those exhibits there is a mention of marine, aquatic and wildlife environments?

A. I see that.

Q. Would that study related to the peregrine falcon be one of those newspaper or magazine articles referred to there?

A. Yes, and keep in mind, this is referring to presence of the PCBs in the samples.

Q. Were there other articles in newspapers that would have prompted the mailing of Exhibits 1 and 2?

A. Yes. I recall a publication out of the University of California, Berkeley, Dr. Robert Risebrough, R-i-s-e-b-r-o-u-g-h, in which he had alleged or suspected that PCBs were responsible for the reproduction problems of the brown pelican off the coast of Southwest California. I also recall an incident that occurred in the North Sea in which seals and birds in large numbers were washed ashore and PCBs were found in their tissues and PCBs were suspected of being the cause for the dead birds and seals.

Q. Was there any conclusion later reached about the brown pelican about what the cause of the problem was?

A. Yes. Dr. Risebrough, in subsequent reporting, concluded that DDT was the cause for the problems he observed, not PCBs.

Q. Not PCB?

A. Not PCBs.

Q. How about with respect to the North Sea seals and birds? Was there a later conclusion?

A. Yes. The British goverment ministries concluded that the results of that incident were due to lack of proper food supply for these creatures and violent storms that hit that area resulting in the death of birds and seals, not PCBs.

Q. Are you familiar with the Yusho incident?

A. Yes.

Q. And would you explain what that is, please?

A. In Japan, in 1968, some oil which is derived from rice bran was contaminated with PCBs that leaked from the heat transfer system used to distill the oil. This contaminated oil was sold for human consumption and the consumers of that oil had various health problems, which included nausea, tiredness, weakness, watery eyes. There was some infants born which were dark colored, as I remember, the pigmented babies. There was some confusion

initially as to what caused all of these symptoms. It was initially concluded that the problems were caused by the presence of PCBs in this rice bran oil. Further studies from that time until 1975, when the conclusion was reached that the cause for all the health symptoms were chlorinated dibenzofurans that were present and not the PCBs.

Q. All right. And the Swedish study, the study on the peregrine falcon, the study on the brown pelican, the study that you read with respect to the North Sea seals and birds and the Yusho incident, all of those things are studies you would have read in connection with your responsibility as Monsanto's manager of environmental control; is that right?

A. That is correct.

Q. You indicated earlier that Monsanto did its own studies with respect to the environmental effects of PCBs and the effects on humans. Based on Monsanto's studies and the studies that you read in connection with your job as manager of environmental control, are you aware of any studies which conclude that PCBs have an adverse effect on human health?

MR. BOLZLE: This is Greg Bolzle for Tim Shook and Rich Montgomery. I'm going to object to the question for the reason that it's irrelevant.

MR. CUNNINGHAM: And while you're typing that down, if you'd indicate that Mr. Cunningham shares in that objection. I think it's an irrelevant question in light of what Congress has done, but that's okay. You can go ahead and answer.

MR. GOEBEL: Wait a minute. It's irrelevant to your claim, is that what you mean, that the hazards of PCBs on human health is irrelevant?

MR. CUNNINGHAM: No. His opinion at to what the hazards are is irrelevant because Congress has already decided that as a matter of law, but we're happy to hear what Mr. Papageorge thinks.

Q. (By Mr. Goebel) With all those objections, Mr. Papageorge, if you can, answer the question.

A. There are reports that would indicate that PCBs under conditions of misuse and mishandling and at high levels of exposure, human beings can get enough of the exposure to result in various health symptoms, the type of symptoms varying with the length of exposure and the amount of material to which they were exposed.

Q. Is the predominant symptom chloracne in those who have high exposure?

A. I don't know that I can use the word "predominant" clearly there. I would suggest that from my experience and perspective, I would suggest that chloracne

is an intermediate warning symptom that exposure is greater than it should be.

Q. Do you know if Monsanto made any conclusions itself about the potential health effects of PCBs on humans during the time you were there?

A. Certainly.

Q. And what were those conclusions?

A. If improperly used and if exposure occurs either through breathing or through skin or ingestion, the health of the human being so exposed would be affected. I don't know how else to explain that, but the labels cautioned against breathing and skin contact.

Q. And that would be by the person who would handle the fluids, for instance, a person who might put the hydraulic oil in a machine?

MR. BOLZLE: I'm going to object to the question. This is Greg Bolzle again. I object to it as to form in that it is leading.

A. That is one example of a type of a person that might be involved with PCBs, yes.

Q. (By Mr. Goebel) Are you familiar with the Kimbrough articles?

A. I'm familiar with several articles by Dr. Kimbrough.

Q. Do you know what those conclusions or what

12

Dr. Kimbrough's conclusions were about the effects of PCBs on humans?

A. Dr. Kimbrough, after many years of studying PCBs and its effect on humans, as I recall, concluded that she could find no cause and effect relationship between PCBs and human beings.

Q. Going back, since there was an objection to the form of the question on the kinds of people who might come into contact with PCBs by inhalation and skin contact, tell me, when you answered that question, besides -- or what kinds of people were you referring to who would come into contact with PCB-containing fluids?

A. Well, there are, of course, the individuals involved with the manufacture of the PCBs, the blending of these PCBs into mixtures that are sold as industrial fluids, the individuals that might be involved during some sort of accident during shipment, this would include all kind, the truck driver or the railroad people or the volunteer fire department, et cetera, the people who received it at the customer's site and unloaded the shipment, the individuals who use that material in the manufacture of a product at the customer's site, again the shipment of the customer's product to his customer, the installation of that piece of equipment at the site of use, the servicing of that equipment while it's in

service, the removal and final disposal of that unit when it no longer served its purpose. There are all types of opportunities for exposure if done improperly.

Q. You were not referring to people who may have come into contact with soil that would have contained a level of PCBs?

A. Well, that's -- that's a result of a mishandling of the material resulting in an unintended exposure and unintended in that it was not intended to be in that soil. So, yes, that could be a group of people involved with clean up and disposal of such conditions that might be exposed.

MR. GOEBEL: Let's take a break. Gerard, would you see if that other fax has come in?

MR. DAVIDSON: Sure.

[Short break was taken.]

[Reporter marked Defendant's Exhibits 6 through 9.]

Q. (By Mr. Goebel) Mr. Papageorge, let me hand you Exhibit No. 6 and ask you if you can identify those documents?

A. Exhibit No. 6 is a collection of copies of Monsanto Company labels for Pydraul F-9 and Pydraul 312. There are examples of seven different labels in this exhibit.

Q. Mr. Bistline in his deposition indicated that

these would have been the labels that would have appeared on the Pydraul F-9 and Pydraul 312 formulas over the years that they were manufactured by Monsanto. Do you know anything differently than that?

A. I do not.

Q. The labels mention chlorinated hydrocarbons. Is that similar to like a polychlorinated product in that it contains a lot of different chlorinated products?

A. Chlorinated hydrocarbons refers to an extremely large family of chemicals, which the hydrocarbons refers to the presence of carbon and hydrogen, and, of course, the word "chlorinated" refers to the presence of chlorine, so that's a very broad family of chemicals in industrial use.

Q. There's no mention in any of the labels in Exhibit 6 of polychlorinated biphenyls by name, is there?

A. There is not. No.

Q. Let me hand you or show you Exhibit No. 7 and ask you if you are familiar with that document?

A. I am.

Q. Mr. Bistline indicated that after, I think he said, May of 1970, Monsanto began affixing an environmental label to any PCB-containing fluid. Is that a photocopy of that label?

A. It is.

Q. Is it my understanding that for all PCB-containing fluids prior to May, 1970, no such environmental label would have appeared? Is that right?

A. That is correct.

Q. And I assume that if there were distributors of Pydraul or PCB-containing fluids that would have had a surplus of PCB-containing fluids on hand when you began putting the label on the fluids in May of 1970, that they would have had to use up their supply without the label after that date before they would have received shipments with that label. Is that right?

A. No. They were sent labels to affix to the containers prior to shipment.

Q. And you would have had to rely on your distributors to affix the label?

A. Yes, sir.

Q. And I think you already said that this kind of label would not have appeared on the PCT-containing fluids, right?

A. That is correct.

Q. Let me refer you to Exhibit No. 8.

A. I have it.

Q. Mr. Bistline described a rubber stamp that was used to stamp invoices. Is this an imprint of that rubber stamp?

13

A. It is.

Q. Do you recall when Monsanto began using the rubber stamp?

A. As best I recall, this stamp was used in the latter part of 1970. I don't recall the specific date, but it seems to me it happened in November or December of 1970.

Q. And then let me refer you to Exhibit 9 which includes several invoices on Pydraul purchased by Russellville from Monsanto. Is it not?

A. Yes. It is.

Q. And nowhere on those invoices does the imprint depicted in Exhibit 8 -- let me start over. Strike that last question. Nowhere on any of the invoices in Exhibit 9 does the imprint of the label depicted in Exhibit 8 appear; is that true?

A. That's true.

Q. And I believe from Mr. Bistline's deposition he indicated that the imprint depicted in Exhibit 8 would have been stamped on the customer's copy --

A. That is correct.

Q. -- of the invoice?

A. That is correct.

Q. So, Monsanto would have to rely on its shipping clerk to stamp each invoice, correct?

13

A. Well, more correctly, it would be the billing clerk as distinguished from a shipping clerk.

Q. Okay. And according to -- well, in the records that we have received from Monsanto, I don't believe there is any invoice that we have received that contains this imprint depicted in Exhibit 8. Are you aware of any?

MR. BOLZLE: I'm going to object to the form of the question. This is Greg Bolzle for Tim Shook and Rich Montgomery.

MR. GOEBEL: On the basis that it's leading?

MR. BOLZLE: Yeah, and argumentative.

Q. (By Mr. Goebel) Let me ask it this way. Are you aware of any Monsanto records regarding the shipment of Pydraul which contain the label depicted in Exhibit 8?

A. I am not.

Q. Let us take just a second here. I may be finished. That's all for now. I don't know who's going to go first here.

CROSS-EXAMINATION

QUESTIONS BY MR. CUNNINGHAM:

Q. Mr. Papageorge, my name is Charles Cunningham. I'll go first here on behalf of the plaintiffs in the various actions that this deposition is being taken for. I'll try to follow the same order that

Mr. Goebel did, starting back at the beginning and coming through and hitting a few things, questions that I had based upon your direct testimony, and then I may have a few things of my own that I may want to inquire about. I notice you said you got your bachelor's degree in 1943?

A. That's correct.

Q. I just got my alumni magazine from our engineering school here and they did an article on the 1943 grads about how they basically all went off to war after they graduated. Did you do any military service?

A. I did.

Q. Where did you serve?

A. Oh, eventually, in the Pacific area.

Q. Which particular --

A. Philippines and Japan.

Q. What particular sort of assignment did you have?

A. I was in the army. I started out in the antiaircraft field, artillery, and went through infantry and ended up finally in the Corps of Engineers.

Q. Okay. You didn't have any real responsibilities that would have been involved in handling any sort of chemicals or anything like that then, it doesn't sound like?

A. Oh, I had an assignment in Japan that

bordered on that. I had the assignment of searching a prefecture in Japan for supplies of chemical warfare materials and equipment. I don't know if that helps you at all.

Q. I was just trying to get an idea of your total background as far as your experience in the area of chemicals and chemical engineering and so forth.

A. Uh-huh.

Q. I thought that perhaps you might have had some duty in the military based on that article I just read about the '43 engineering grads. You mentioned when you worked with Phillips Petroleum you had worked with some drilling fluids. Is that what a lot of people in the industry call drilling mud?

A. Yes, sir.

Q. Let me ask you for a moment here about your experience down there in Anniston, Alabama. What part of Alabama is that in?

A. Oh, it's in the middle of the state, about an hour east of Birmingham and two hours west of Atlanta.

Q. Is that on any particular stream?

A. Oh, the Cousa River runs --

Q. Which river?

A. Cousa, C-o-u-s-a, runs in that general vicinity, and there are some man-made lakes there.

14

Q. Okay. It's my experience that most chemical plants require a fair amount of water either for process water or feed stock. What was your source of water there at that particular plant?

A. It's the Anniston municipal water system.

Q. Are you aware of any sort of environmental PCB contamination that has emanated from that plant? It seemed like, for as many years as that plant operated, I guess for a while without anyone thinking there was a problem with this particular chemical, there might well be some environmental contamination. Are you aware of any?

A. I recall some samples made of soil from a nearby natural draining -- drainage ditch which was referred to as Snow Creek that ran by the plant property and PCBs were found in those samples.

Q. Do you have any idea of how many linear yards or miles of stream or ditch line were contaminated?

A. I don't recall the number any longer.

Q. Well, let me see if I can put it this way. Do you recall it as probably being less than a mile or more than a mile?

A. As best I can recall, it was about a mile. It wasn't much more than a mile.

Q. Okay. And do you know when they first started to manufacture PCB compounds at that particular

14

chemical plant?

A. I understand the Swan Company started in 1929.

Q. And the production of those type of compounds ceased in the early '70s?

A. At that plant, yes, sir.

Q. All right. So, we've got 40 some odd years of manufacturing. When was that sampling done there at Snow Creek; do you recall? Was it before or after '71 or '72?

A. About that time really, about '71.

Q. All right. Now, you were asked on direct whether or not there were any other compounds that could do the job of the PCBs, and my recollection of your answer was that they did it best. You weren't aware of anything that did it as well; is that correct?

A. That is correct.

Q. I had seen some literature from Monsanto that led me to conclude that your all's new formulations from the '70s, I guess these phosphate esters, would give you just as good of performance. Are you not really of that opinion? Not to be obtuse, I'm looking specifically at a letter dated April 15, 1971 from a C. Larry Bradford, product manager, hydraulics and lubricants. It's addressed, "Dear Sir: I have currently went through most

of your PCB or, rather, Pydraul customers," and he says in there at the end, at the last sentence, "The reformulated products you are now using will give you equal or better performance than you previously had, and with no PCBs." And I guess what I'm asking is whether or not you concur with that statement that Mr. Bradford made?

A. I concur with Mr. Bradford's statement made in 1971, --

Q. Okay.

A. -- but my prior remarks relating to the available alternatives for PCBs in the '50s and '60s and so on, there were no known alternatives. The phosphate esters which were finally developed for use by Monsanto were new chemicals introduced into commerce.

Q. Monsanto created, as I understand it again from these letters, specifically with the mind as a replacement for the PCB compound; is that correct?

A. That is correct.

Q. And I want to say page 107, which was one of our exhibits, Exhibit 4, specifically indicated that these new compounds -- that the pricing is competitive with the present Pydraul line. Was that your recollection as well? From an economic standpoint, phosphate esters were competitive with the cost of the Pydrauls?

A. Yes, but what -- I've lost track of the

timing here. What year are you referring to now?

Q. Exhibit 4 is a letter from 1972.

A. Oh.

Q. Do you have Exhibit 4 handy?

A. I have it.

Q. It's the last sentence of the second paragraph.

A. Yes.

Q. Okay.

A. That does refer to the phosphate ester fluids.

Q. Right.

A. The reason I was confused, Mr. Bradford's letter that we referred to earlier, --

Q. Yes, sir.

A. -- that was referring to really chlorinated hydrocarbons in the form of PCTs being used in the earlier reformulations.

Q. Okay. I thought you had ceased using even those by 1973?

A. That's true, but you had referred to Mr. Bradford's letter and the reference to equal or better performance. That is comparing one chlorinated hydrocarbon with another as compared to comparing a chlorinated hydrocarbon like a PCB with a phosphate ester.

That's a different kind of comparison.

Q. All right. Well, then, let me ask you to make that comparison between the performance of a polychlorinated biphenyl compound hydraulic fluid versus a phosphate ester compound hydraulic fluid.

A. Well, eventually, it's my understanding, and keep in mind I'm no expert, but the phosphate ester developed by Monsanto and the production unit built and designed to produce it was, for all practical purposes, comparable in the type of properties that used to be achieved with PCB and PCT mixtures.

Q. Okay. And I understand. That's a fair response. And in fact, it kind of leads me to my next question, which was going to be that -- I'm assuming, while you're very familiar with or at least somewhat familiar with most of the products that Monsanto may have sold and marketed and manufactured over the years for hydraulic fluids, that you may not be as knowledgeable about the particular fire retardant, fire resistant hydraulic fluids for industrial uses that Monsanto's competitors may have been marketing in the '50s and '60s and '70s. Is that a fair statement?

A. It is.

Q. Okay. I would like to talk to you now a little bit about your waste water control system down

there in Anniston that you described for us.

A. Yes, sir.

Q. I understand you used dual lagoons with clay liners, and was it crushed limestone that you were using for neutralization?

A. Yes, sir.

Q. Okay. And then you would drum the sediment that would result in the aggregate and dispose of that in situ there at the facility? Do you know if they had any sort of a situation subsequent where the state of Alabama or federal EPA has come back to monitor that landfilling facility?

MR. GOEBEL: Objection. Irrelevant.

A. I know that the regulatory representatives from the state have visited the plant and made an investigation. I don't know the degree of monitoring that you might have in mind. They were satisfied with the -- with what they saw, and that's where it now stands, to the best of my knowledge.

Q. (By Mr. Cunningham) I guess I'm curious as to why you would have bothered putting that stuff out in the lagoon, why you wouldn't just let it get out into a drainage ditch and go on out to the creek or whatever. Was it your perspective that good engineering practices in the '60s would have mandated that a waste stream that

potentially would have contained PCBs should have been segregated in the manner that you have described that you all did in that facility, at a minimum?

A. At a minimum, it is just not prudent to discharge knowingly any kind of industrial chemical, whether it be PCBs or any other material, and the sediment that collected in that pond was just the type of thing that you wouldn't want to discharge out into the environment. It just wasn't a practice that was considered to be responsible. That's all.

Q. It's from the nuisance aspects and esthetic aspects of discharging something like that that you just wouldn't do it, right?

A. That's part of it.

Q. Okay. Mr. Papageorge, you put a qualifier in there about not -- you wouldn't want to discharge any industrial waste stream like that into the environment knowingly. I want you to assume for the purposes of my next question that -- I think you can look at the last exhibit we had entered which would show what Rockwell's consumption of Pydraul was for -- I want to say these invoices cover from like the '71 through '72 years. I think if you look there, you will see that they were consuming Pydraul in fairly significant quantities. Sometimes it looks like ten 55-gallon drums -- 54-gallon

drums on a monthly or every other monthly basis. Based upon your understanding of how PCB holds up in an industrial setting as a hydraulic fluid, can't we safely assume that that Pydraul had to be -- it wasn't breaking down; isn't that correct? Pydraul does not necessarily break down as a hydraulic fluid and decompose?

MR. GOEBEL: Let me object to the form. This is Tony Goebel.

Q. (By Mr. Cunningham) The reason you'd have to buy more Pydraul is because either its leaked out and gotten into your facility somewhere or you're adding capacity? It's not because the Pydraul has broken down and decomposed, correct?

MR. GOEBEL: Again, object to the form of the question.

A. My reason for hesitating is, I find that I need a lot more information regarding what goes on at the site. I'd be speculating as to whether the material is damaged because of a misuse, or if it isn't kept in the system, where does it really end up? It might be very responsibly handled somehow. I'd be guessing, totally guessing.

Q. (By Mr. Cunningham) Let me put it this way. If you were plant manager of a facility that was using this much Pydraul, would you want to know where it was

16

going, where it was ending up?

A. If I were the plant manager? I probably would know.

Q. Okay. Sir, can you tell me what the specific gravity of Pydraul is? I assume it varies from one Pydraul to another, but as a general statement, is Pydraul typically more than 1.0 or less than 1.0? To be less than 2, my understanding is that that would mean heavier than water or lighter than water?

A. I would suggest that it's heavier than water. Just the labels themselves would give you a good reading on that. You'll note on Exhibit 6, 141, a 55-gallon drum weighs 590 pounds. That makes it more than the 8. so pounds per gallon that water is, which would be a specific gravity of 1.

Q. Okay. And just to get a few other bits of information about PCBs from a guy who used to manufacture them, I understand that they are -- persist in the environment? In this sense, for instance, there's a lot of hydrocarbons that may be found in various pesticides that are specifically formulated not to be persistent with the idea that they will get in, do their job and then degrade into less toxic substances. Am I correct in my understanding that PCBs were not a substance which was expected to degrade and that in reality held up, for lack

of a better word, rather well in the normal environment?

A. That was the perception of the material. Yes, sir.

Q. Okay. And the main difference between a -- you told us, between an Aroclor 1248 and Aroclor 1260 was that there was a greater degree of chlorination of the biphenyl ring with a 1260 compound than with a 1248?

A. Yes.

Q. And am I correct in understanding that as a practical matter, the real world significance of that difference was that you -- primarily the degree of viscosity?

A. Oh, that's one measure. The higher the chlorination level, the more viscous the material. The higher the chlorination level, the more fire resistant the material. So, there are other properties associated with the presence of more chlorine.

Q. Okay. And another property of PCBs, as I understand it, is that they are -- I think the word is lipophilic, but, in essence, it's attracted and tends to get bound up in soil, sediments, sludges; is that correct?

A. Oh, your use of the expression lipophilic, I don't associate that with soils and sediment.

Q. Okay. Well, --

A. I'm confused --

Q. -- that's probably because I don't know.

A. -- with your question.

Q. You tell me. Is it hydrophobic? It doesn't particularly dissolve in water very well; is that correct?

A. That is correct.

Q. Indeed, what is considered to be a saturation level for water, PCB?

A. Depending on the level of chlorination, the lower chlorinated being a little more soluble, as I recall, at ambient, average kinds of temperatures, the solubility is about 200 parts per billion with a "B".

Q. I had heard of stuff actually lower by order of magnitude than that.

A. Yeah. There are some of the higher ones that are down in the 10 and 50 parts per billion level.

Q. Okay. Do you have any idea what Aroclor 1248 -- where -- the range that falls?

A. I would suggest 48 is more like the hundred part per billion.

Q. Okay. You had testified earlier that you -- your recollection was that F-9 -- Pydraul F-9 contained primarily 1248 Aroclor? The 312, you thought, also contained 1248, but also 1242, and that A-200 contained 1242, but I wasn't convinced that you were positive on that. How sure are you that Aroclor -- that Pydraul 312

17

contained Aroclor 1242?

A. Well, my memory isn't crystal clear after all these years, but I'd have to --

Q. Let me put it a different way. If we wanted to be sure, is there some sort of documentation that one could resort to that would give us a better answer on that, a definitive answer?

A. Yes. I would attempt to find some records which would reflect the -- let me call it the recipe of what went into this blend.

Q. Okay. Well, cooking is kind of a hobby of mine, and I kind of enjoy reading recipes, so maybe we could make a request of you, at your leisure, this isn't an urgent thing, but if you could find the recipe for F-9 and 312, we'd love to see it. I presume you don't have a proprietary concern over it anymore since you're not allowed to market it in the U.S., or do you still sell it overseas? Do you have some concern about controlling the release of that recipe? Maybe I should direct that to your attorney.

A. Oh, I'd have to -- yeah. The --

MR. DAVIDSON: Mr. Papageorge doesn't have any records. The request would have to be made to Monsanto, probably to Mr. Bistline, or I can convey it. We don't have any problem with describing it. If you want

me on the record about it, I can tell you that the Aroclor -- the Pydraul 312 component -- PCB component was Aroclor 1242 and the A-200 components were Aroclor 1242 and 1248. Bill just had those two reversed in his earlier testimony.

Q. (By Mr. Cunningham) Let me talk to you a moment here, Mr. Papageorge, about the purity on this stuff. How much of -- on a weight percent, how much of a Pydraul, say, F-9 would have been an Aroclor or a PCB compound versus some other sort of substance?

A. Oh, I don't remember the proportions at all. Again, I'd have to look up the recipe to determine that.

Q. Well, let me inquire again, in the broadest range to feel comfortable, are we taking about a substance that is at least half polychlorinated biphenyls or something less than half, or do you even feel comfortable trying that?

A. I -- there were so many Pydraul mixtures and variations within each type of Pydraul that I am, at this point, unable to recall which is which.

Q. All right. Then, could you tell me just real quick some of the other things I might find in some of the Pydrauls aside from PCBs, and you've already described PCTs? Other than those, what else might we expect to find in a recipe?

A. You might find some mineral oil. You might find -- well, we mentioned the phosphate esters.

Q. Now, were they around in the '60s?

A. What? The phosphate esters?

Q. Right. I'm sorry. I perhaps was not very artful in my question. I'm looking primarily at the formulation of the Pydrauls in the late '50s and throughout the 1960s.

A. There were some phosphate esters available.

Q. Okay. And the mineral oil which you mentioned. Anything else that immediately comes to mind as a component of these things?

A. Not of significance. No. There's the usual color additives and -- but nothing of significance.

Q. What color was Pydraul? Was there a particular color or did that vary?

A. That varied with time. I recall sort of a reddish-purplish color. I just -- it changed with time.

Q. Okay. I'm curious to know about the possible contamination components. I assume that any time you're making a chemical compound, the chemical reaction that leads to that is not necessarily 100 percent efficient and that you may have in your finished material certain minute quantities of contaminants or unreactive feed stock or what have you. Do you have any feel for what sort of

purity you were able to attain with these Pydrauls?

A. I have no idea.

Q. When we talk about -- I guess the analogy I want to try and take you to is petroleum products because that's what I'm more familiar with. When you put petroleum through a cracker and you start taking off your fractions at different levels, there's a little crossover, in other words, you might get at one particular level primarily, you know, like at the bottom asphalt, but you still have some of your lighter fractions in there. Was the same thing true when you were making these PCB compounds? You could draw it off, looking for 1248, and get predominantly 1248, but would you at the same time get some 1242 in there, some 1254, or was it a pretty -- a process that led to a pretty pure fraction?

A. Well, keep in mind that the fraction collected and sold as a product in itself was a mixture of the 1, 2, 3, 4, 5 chlorobiphenyls.

Q. Okay.

A. The distillation was conducted under certain pressures and temperatures. The resulting product, although identified as, say, a 1242 indicating a 42 percent by weight chlorine, might vary a couple percent. It might be 1240 to 1243 range. Within that mixture there could be varying amounts of the 5 chloro, the 4 chloro,

the 3 chloro and so on PCBs. It is not a distinct, pure chemical entity that is sold.

Q. Okay. And that was my understanding, and I appreciate you clarifying that for me. Then what you would do, I think, is you'd take your end product and put it in a gas chromatograph or a mass gasometer and it would come off with a reading based upon the average degree of chlorination, and that's how you'd label it, right, a little bit of all these different things, but --

A. It depends. At what period of time are we talking about now? Does that matter? You mentioned gas chromatography and all. That developed in the late '60s and '70s, and the graph that is generated by the instrument and is commonly referred to as the fingerprint where the peaks and valleys represent the different levels of chlorination, they would vary from batch to batch of material, but not significantly.

Q. But the bottom line is that when you get a fingerprint for an Aroclor now a days from a gas chromatograph, to some extent, you're getting kind of an average of the PCB molecules that you're burning off, right?

A. Average, or you might want to use the word typical.

Q. Okay. That's fair.

A. This fingerprint is typical of 1242 or of 1254. It is -- no two are exactly alike.

Q. Right. And in reality, you're going to have some molecules from several different biphenyl rings, but that's -- the fingerprint will be typical of that compound which has that particular number showing up most often, that degree of chlorination showing up most often?

A. Yes.

Q. Okay. I'd like you to take a look at Exhibit 2 for just a second, please, and specifically the page labeled Rockwell 00054.

A. I have it.

Q. That appears to me to be an alphabetical listing of summary of water quality standards for all 50 states, and about two-thirds of the way down there there's a summary of requirements for water quality in Kentucky. Do you see that?

A. I see that. Yes.

Q. Can you read for me under other remarks or other requirements what they say for Kentucky? My copy is pretty lousy, but I'm hoping yours might be better.

A. I don't know if it's my copy or my eyes. You're asking under other requirements?

Q. Correct.

A. I'll try to read it. Color, taste and

odors --

Q. Wastes maybe?

A. -- wastes must not create a nuisance.

Q. Okay.

A. I can't read the next word. Something about dissolved solids must not exceed 1,000 milligrams per liter. Monthly average, 7 -- I can't tell if those are zeroes or not -- I'm going to call it 700 milligrams per liter. No floating waste in unsightly or --

Q. Would that be deleterious?

A. -- or deleterious amounts. No other wastes that settle to form putrescent or objectionable sludges. I can't read the next word. Wait a minute. No. I can't read the next two words.

Q. Okay.

A. No waste in -- I can't read the other word -- or combinations harmful to humans, animal, plant or --

Q. Aquatic?

A. -- aquatic life.

Q. Thank you. Let me take you next to your discussion of the Yusho event in Japan in the late '60s. My recollection of your testimony was that your understanding of the medical literature was that eventually the adverse human health effects that were detected in that particular exposed population was

attributed to dibenzofurans as opposed to PCBs. Is that correct?

A. Yeah. The chlorinated dibenzofurans.

Q. Okay. Do you know where those came from?

A. What came from?

Q. The chlorinated dibenzofurans. For the court reporter's benefit, can we maybe just shorten that up to CDBFs or something?

A. I have no -- no information that would help me determine exactly where those materials came from.

Q. Aren't furans a known contaminant in PCB compounds?

A. Yes.

Q. In fact, in most chlorinated hydrocarbons there's a potential for the production of minute quantities of that particular contaminant?

A. Not -- when you say chlorinated hydrocarbons, I have to say that that's not correct.

Q. Okay. Well, I don't care much about the rest of it anyway. The bottom line is, there is technical data that has indicated that dibenzofurans -- chlorinated dibenzofurans occasionally occur as a byproduct or a contaminant or a decomposition product in PCB compounds, correct?

A. That is correct.

19

Q. So, even if there was a different particular chemical that caused these particular adverse health effects, if that particular chemical happened to be a contaminant or waste product or decomposition product of the PCBs, in a sense, these folks' illnesses were still attributable to the PCB contamination or the contamination of that fluid?

MR. GOEBEL: I'm going to object to the form of the question. This is Tony Goebel.

A. You've made a big jump into a conclusion. Let me suggest that -- keep in mind that the PCB involved at the Yusho incident was, first of all, a Japanese company, not the one that's associated with Monsanto. We -- at least I don't know all the conditions that existed during the incident and what created the presence of the dibenzofurans in that Japanese PCB, whether it was present originally in the material or whether it occurred because of the leak and the exposure to the high temperature, the air and the oil.

Q. (By Mr. Cunningham) Okay. That's fair.

A. There are a lot of new factors introduced in that particular incident.

Q. Okay. You had a fair degree of discussion with Mr. Goebel about human health effects. Are you of the opinion that PCB compounds have any deleterious

effects on plant or animal life?

A. I have no information at all that tells me that PCBs are harmful to plant life. There are some studies that demonstrate that PCBs do affect some creatures in nature. The one that comes to mind is the study made in Florida relating to young shrimp that were sensitive to very low concentrations of PCBs. We do know, too, that PCBs have demonstrated that they do affect the egg laying and reproduction of chickens. I, at the moment, can't recall any other study that demonstrates a harmful effect of PCBs to wildlife or domestic life even.

Q. Okay. Have you, in your job there with Monsanto, been charged with the task of doing any sort of environmental auditing or what is sometimes referred to as due diligence with respect to either the sale of properties by Monsanto that may have been contaminated in the past with PCBs or the purchase by Monsanto of facilities that may have in the past been so contaminated?

A. I have never been involved with that type of situation and I don't know of any Monsanto involvement with -- with that kind of situation.

Q. Taking it from the perspective of property Monsanto already owns, you're not aware of there being a problem at any of their facilities with soil contamination with PCBs?

A. I am not.

Q. Do you know how extensively PCB may have been utilized in Monsanto industrial processes in the '60s and '50s based upon your experience with them and even running the plant there for a while?

A. I don't know how to define extensively. Monsanto, of course, used PCBs in its electrical equipment, in its heat transfer equipment, its hydraulic systems.

Q. I would assume it would, in fact, be the hydraulic fluid and the dielectric fluid of choice for Monsanto; would it not?

A. It depends on the application.

Q. Okay. Well, they weren't going to be buying a competitor's product? Let me put it that way.

A. Well, economics comes to play here, also.

Q. Okay.

A. If a mineral oil in a transformer will do the job, that's what they would buy.

Q. Well, sure, if you didn't need these special characteristics of a Pydraul, it made it worthwhile to spend the extra money on the fire retardant aspects of it, but when you did need that kind of special characteristic, that's what they would use, no doubt, right?

A. All things being equal, yes, they would

prefer the Monsanto product.

Q. And I can't pronounce the name of the place up there. Sauget?

A. Sauget.

Q. Sauget, Illinois. They made some PCB up there. Are you aware of any sort of contamination problem they now face in Illinois by that plant as a result of use or misuse of those fluids?

A. I am not.

Q. And how many years were they actually manufacturing the stuff there at that particular facility?

A. From 1935 or 6 or somewhere in there to 1977.

Q. You were there at that plant for a while. Do you know what their process was for treating potentially contaminated -- or maybe that's too strong a word -- waste water streams that may have had contact and even contained PCB solutions and fluids at that plant?

A. All the waste water from that plant went to the Sauget Village municipal treatment plant.

Q. Okay. And do you know if that particular facility had specialized treatment mechanisms for treatment of industrial waste fluids?

A. Yes. I would -- I suspect that the word specialized might fit. They were handling industrial wastes from the entire community. The water that was

eventually released from that plant had to meet the appropriate regulatory specifications. The wastes were carried to an approved landfill.

Q. You're not aware of any problems that that municipality has had subsequently wherein it has been revealed that there's been some sort of downstream contamination from the operation of that waste water treatment facility; is that correct?

A. That is correct.

Q. Thank you, sir. I appreciate your time. Mr. Bolzle may have a few questions.

CROSS-EXAMINATION

QUESTIONS BY MR. BOLZLE:

Q. Mr. Papageorge, my name is Greg Bolzle. I'm representing Tim Shook and Rich Montgomery. I will try not to be repetitive. If there are long silences, it's simply because I'm looking at my notes and trying to avoid asking you questions you've already been asked.

A. I understand.

Q. Mr. Papageorge, let me begin by talking to you about tests. We've talked about a number of tests in your deposition, the Swedish test, we talked about peregrine falcon tests, brown falcon tests, dead birds and seals tests. What I wanted to ask you is, as I understand it, Monsanto did its own tests as to the potential hazards

of PCBs; is that correct?

A. Yes. We did.

Q. And it was Monsanto's conclusion that PCBs could be hazardous to human health depending upon the length and degree of exposure; is that correct?

A. Yes.

Q. And that that could include people exposed to soil contaminated with PCBs as a result of mishandling depending again on length and duration of exposure; is that right, sir?

A. Well, yes, but when I think of the word exposure, I'm talking now about the amount of PCB that enters the lungs through breathing, the vapors, or the amount of PCB that's on a person's skin to be absorbed by that skin and the amount of PCBs that might be in any food that's ingested, so just having PCBs in soil, that is another consideration as to how did that soil get on the skin, how did that soil get into the lungs, how did that soil get into the digestive system.

Q. Certainly. To make it simple, you wouldn't want your children drinking water that was contaminated with PCBs, would you, sir?

MR. DAVIDSON: I'm going to object and instruct him not to answer that one.

MR. GOEBEL: Yeah. I join in that objection.

This is Tony Goebel.

Q. (By Mr. Bolzle) Now, Mr. Papageorge, you testified that back in the '50s, and I want to be certain my facts are clear on this, back in the '50s, you were working at the J.F. Queeny Plant; is that correct?

A. That is correct.

Q. And that at that plant you were one of five or six general superintendents and that you became -- you first became familiar with PCBs in 1956 while working as a plant maintenance -- in the plant maintenance and construction department; is that correct?

A. Well, some of it is correct, but you're reference to one of five general superintendents, --

Q. Yes, sir.

A. -- that was at the Krummrich plant in 1964.

Q. Okay. I don't mean -- I don't want to confuse you.

A. Mm-hm.

Q. When you were working in the plant maintenance and construction department, was that at the J.F. Queeny Plant?

A. That is correct.

Q. And there you were a manager of a team of workers who installed new equipment, --

A. Yes, sir.

Q. -- correct? You testified that you became familiar with PCBs as a part of your job then when installing PCB-filled equipment and that sort of thing; is that right?

A. That's correct.

Q. Why was it that you became familiar with PCBs at that time?

A. Well, this is no different than becoming familiar with any other materials we handle, and it's the responsibility of the supervisor to inform the workers of any potential problems that might occur, whether it be from exposability or corosiveness or skin irritation or dust inhalation, whatever the potential problem might be. I don't think that this stood out as any unique need. It was an ongoing situation. Information of this type was conveyed during the employee safety meetings and so on that are held.

Q. My question is, I guess, did you become familiar with PCBs in about 1956 in the capacity we're discussing because of the concerns about the hazards associated with handling and coming into contact with PCBs?

A. The concerns in the mishandling of the PCBs in this instance as well as all other materials we were handling.

Q. And specifically with regard to the PCBs, would the mishandling -- the result of mishandling that caused you concern, potential adverse effects to human health?

A. No. It's not the resulting mishandling. The purpose of conveying this information is to avoid mishandling so that the worker doesn't have to undergo any -- any problems with overexposure.

Q. What was the source at that time of your information about PCBs?

A. There were written documents, I'll call them, that were available for my review and sharing with the employees. There was also available to me the personal comments from the plant physician with whom I had discussions, and myself, the information that I got from the corporate industrial hygienist who would occasionally visit the plant, and keep in mind, too, that the labels had words that referred to ingestion, skin contact, breathing of the fumes and so on.

Q. Do you have an opinion, Mr. Papageorge, whether back in 1956 it was a matter of common industrial knowledge the potential hazards that PCBs might represent to human health as a result of mishandling?

A. I would suggest, yes, that there was an opportunity to learn of this potential for problems if

mishandled.

Q. Mr. Papageorge, based on your familiarity with the subject of PCBs and your readings over the years, would you agree with me that there have been scientific articles and publications available since as early as the 1930s that raised questions about the possible hazards to human health posed by PCBs in the event they were mishandled?

A. Well, certainly, the information was available, but keep in mind again the conditions that must exist to create this health situation, and that is again back to the comment you made earlier about how long was the exposure and how great or how intense was the exposure.

Q. Let me turn to the Anniston, Alabama plant. The pond in which you all discharged your industrial waste water, you said, would be frequently bulldozed to remove the contaminated sediment and the rocks in that pond. Can you give me some more definite idea, Mr. Papageorge, of how frequently you all bulldozed that pond?

A. Did I use the word "frequently?"

Q. Yes, sir.

A. Okay. I should have said periodically.

Q. Okay.

A. As best I recall, it would happen about twice

a year.

Q. Okay. And just to make sure I understand your use of the word "bulldozed," you didn't bury contaminated sediment right there at the pond? When you say bulldozed, you mean you took it out and took it for burial at a landfill; is that correct?

A. Yeah. Maybe the word "bulldoze" is inappropriate. It was really sort of a backhoe that reached out and scooped up the material from the pond and dropped it in these open topped steel drums. The drums were then covered with their metal cover, hosed down so the outside was fairly clean and then hauled to the landfill.

Q. Now, this pond that you all used in Anniston, Alabama was lined with clay; was it not?

A. Yes, sir.

Q. And that was done in order to protect -- to prevent contamination of the ground water; is that correct?

A. Yes. That's the purpose for that clay lining.

Q. Do you know whether there was any hydrogeologic studies performed by Monsanto of the area where this pond sat before it was, in fact, constructed and used for discharge of waste water?

A. That, I don't know.

Q. Okay. But at least as far back as 1965, Monsanto understood that it had to line such a pond in order to prevent contamination of the ground water; is that correct?

A. Well, I don't -- let me just say contamination of anything below the bottom of that pond, whether it was ground water or soil or what have you, it's really immaterial as long as we didn't contaminate anything.

Q. Exactly. That was the point of it all, right?

A. Yes, sir.

Q. And even when you all would dig out the sediment twice a year in that pond, to be sure of that, you would then go back and re-line that pond with clay; is that correct?

A. That is correct.

Q. Now, could you describe to me what steps were taken by Monsanto with that pond to prevent any leaking of its contents such that it would contaminate surface water?

A. I don't recall any special steps that were taken.

Q. Did you all have any leaking problems with that pond?

A. Not that we were aware of. No.

Q. Did your all's waste water management at the plant include regular inspections of the pond to insure that it was not leaking?

A. Yes. These were really visual inspections to see where the liquid level was and whether there was any dramatic changes in it, unexpected changes which would indicate there's some -- something different was going on. It was not what I would call a sophisticated type of monitoring that would, of course, take place today.

Q. Sure. How often would those inspections occur?

A. Oh, virtually every day. The operators of that pond would be out there making their observations.

Q. Okay. And let me take you back to 1965. Is it your opinion, Mr. Papageorge, that as far back as 1965, to do otherwise in the management of a pond into which industrial waste water was being discharged would have been imprudent and poor engineering practice?

MR. GOEBEL: I object to the form and -- I object to the form of the question. This is Tony Goebel.

A. Yes. I would.

Q. (By Mr. Bolzle) Mr. Papageorge, there was some discussion between you and Mr. Cunningham about solubility of PCBs in water, and I think you estimated

that the solubility of Aroclor 1248 in water would be somewhere around 100 parts per billion; is that correct?

A. That is my best estimate at this time. Yes, sir.

Q. If you took a sample of water and you discovered that there were 100 parts per billion Aroclor 1248 in that water, would it mean -- what would the significance of that sample mean to you?

A. Oh, I don't know how to define your word "significance."

Q. Let me ask it this way. Would that mean to you that that sample of water was saturated with Aroclor 1248?

A. Assuming that the laboratory has the expertise to get down to these levels and that no contamination has occurred in that laboratory -- and I say this from my personal experience, that some numbers that I've seen were incorrect to start with. I'd have to make a lot of speculations regarding what conclusions I would arrive when I'm giving that kind of number. I'd have to know much more.

Q. Well, let me put it to you this way. If you took a sample of water, if you personally took a sample of water, under any and all conditions, satisfying your requisite level of accuracy, and that sample when tested

showed that it had 100 parts per billion of Aroclor 1248, would you take from that that the water was saturated with Aroclor 1248?

MR. GOEBEL: I object to the form. He's already said it calls for speculation.

A. I'd have to know if that sample that you're describing for me is water alone or does it have sediment still in it. It may not be visible to the naked eye.

Q. (By Mr. Bolzle) Sure.

A. And if there is sediment, then I would associate the PCBs with the sediment rather than with the water. So, you're asking me again to kind of speculate as to what that information is telling me.

Q. Okay. Let me ask you to assume that it's just pure water with no sediment level in it whatsoever.

A. Let's take the water and filter it first and then analyze it, huh?

Q. Right. And you come out with 100 parts per billion Aroclor 1248. Would that mean in your mind that it was saturated with Aroclor 1248?

A. All right. Help me with the word "saturated" now.

MR. GOEBEL: Wait a minute. Let me object to the question, to the form of it. There's no foundation and no evidence that's been afforded in this case. You

can go ahead and answer it if you can.

THE WITNESS: Well, I asked if he would help me with the word "saturated."

Q. (By Mr. Bolzle) And I may be -- my terminology may be wrong, Mr. Papageorge. I'm just looking for what the significance of that 100 parts per billion reading would be. Does that mean -- would that reading reflect that the water is holding all the Aroclor 1248 it could be expected to hold?

MR. GOEBEL: Same objections as before.

A. When I gave the number 100, I had in mind a situation where -- pure water, when exposed to Aroclor 1248, under normal room temperatures, can be expected to be able to contain -- in solution and not as material that's settled at the bottom or exists as globules, in solution, would be expected to have about 100 parts per billion in it.

Q. (By Mr. Bolzle) Okay. You wouldn't expect that the water could hold any more than that?

A. Probably not, because the minute you add more, it'll start settling out.

Q. Okay. I got you. Referring to the documents, specifically Exhibits 1 and 2, Mr. Papageorge, Mr. Goebel asked you a number of questions, if you distinguished Aroclors 1254 and 1260 from Aroclor 1248

with regard to those documents. My question for you is, at some point, I take it Monsanto stopped producing Pydraul that contained Aroclor 1248; is that correct?

A. Yes.

Q. And when did -- did that occur in 1971?

A. Yes.

Q. And why did Monsanto stop manufacturing Pydraul with Aroclor 1248 in it?

A. Well, since they had success with the phosphate ester we talked about earlier and found it to be an acceptable alternate and since the facility for producing the phosphate ester was in place, it was decided to remove all chlorinated chemicals from the Pydraul product line and use the phosphate ester to give the fire resistant property.

Q. Were concerns about potential environmental contamination with the chlorinated compounds part of that decision?

A. Well, especially the higher chlorinated parts of the 1242 were perceived to be potential sources out there in the environment that resembled the kinds of things that were found in 1254 and 1260.

Q. Okay. And that gets down to, I guess, my point, and that is, at some point, Monsanto came to the same concerns about 1248 -- Aroclor 1248 that they

expressed in their letters about 1254 and 1260 that were made Exhibits 1 and 2 to your deposition; is that correct?

A. That is correct.

Q. I think my last question for you, Mr. Papageorge, looking at Exhibit 9, which is these invoices, --

A. I have them.

Q. -- are those customer copies or your company's copies?

A. Company copies.

Q. Okay. These are not the customer copies; is that correct?

A. That is correct.

Q. And it was to the customer copies that the stamp warnings of the hazardous PCBs was affixed; is that correct?

A. That is correct.

Q. Okay, sir. So, by looking at these documents that have been marked Exhibit 9 to your deposition, we can't tell whether or not there were -- that that stamp -- whether that stamp was affixed to the copies of these invoices received by Rockwell, can we?

A. Not by looking at this exhibit, no.

Q. Okay. Mr. Papageorge, I thank you.

A. Thank you.

MR. GOEBEL: I've got just a couple, of course. Hold on just a second. It'll take me just a minute here.

[Short break was taken.]

MR. GOEBEL: I'm back, and I just have a couple of questions. Gerard, do you have a document of September 1st, 1960, Bates stamped 28? It begins there.

MR. DAVIDSON: Yes.

MR. GOEBEL: And its got three attachments to it?

MR. DAVIDSON: I don't have any -- attachments?

MR. GOEBEL: Yeah. Look at the page two.

MR. DAVIDSON: Okay.

MR. GOEBEL: It should be starting on 30.

MR. DAVIDSON: Hang on a minute. Yes. It's 028 through 048.

MR. GOEBEL: All right. I don't even know if we need to mark it. Yeah. Why don't we go ahead and mark that? I guess that will be what?

MR. DAVIDSON: 10.

[Reporter marked Defendant's Exhibit 10.]

REDIRECT EXAMINATION

QUESTIONS BY MR. GOEBEL:

Q. Mr. Papageorge, let me refer you to Exhibit

No. 10, --

A. I have it.

Q. -- specifically the first attachment, a Pydraul A-200 brochure?

A. I have it.

Q. On the page Bates stamp 33, there's a section on that page entitled Handling and Storage?

A. I see it.

Q. And there's a statement that certain precautions should be used when handling Pydraul, and it says, "Repeated or continuous skin contact should be avoided and inhalation of the vapors at elevated temperatures should be prevented?"

A. I see it.

Q. It also says, "There is no vapor inhalation hazard associated with use at room temperature." Do you see that?

A. Yes. I do.

Q. This brochure, I assume, would have been dated in the late '50s, early '60s, right?

A. That's -- down at the lower left-hand corner of that page, you will see a series of numbers. You will see there a 0359 within that series.

Q. All right.

A. That tells me March of '59.

Q. Okay. When you, on cross-examination, described mishandling and hazards to human health if mishandling occurred, is this what you were referring to, the repeated skin contact and inhalation?

A. Yes.

Q. And you said it was common knowledge at the time about that, that if it were mishandled, that these kinds of things could occur? You were referring, were you not, to the -- a mishandling by the worker or the person who had to transport or come into direct contact with the PCB-containing fluid; is that right?

A. Yes, sir.

MR. BOLZLE: This is Greg Bolzle for Tim Shook and Rich Montgomery. I'll object to that. I think Mr. Papageorge has been very clear it can extend not only to the people who handled it but the victims of the people who mishandled it.

MR. GOEBEL: I think that's a mischaracterization of what he said.

Q. (By Mr. Goebel) You can try to clarify it, if you like, but you can go ahead and answer the question, please.

A. Well, I was trying to point out that if the precautions as described in this document and on the labels were followed, and I have reference here to the

skin contact and inhalation of vapors, if those words were heeded by any person handling these materials, no health effects would result.

Q. And when you referred to mishandling, you were referring to the person who would have handled the material?

A. Well, naturally. It's the person that has no respect for it, for example, and keeps putting his hands in it time after time and ignores the fact that his hands are getting red, the skin is getting red, and keeps doing it. Eventually, he's going to get more serious problems. He's going to get the chloracne we talked about, and in fact, his liver could be damaged and on and on depending again on how long and how often he does this.

Q. That's all I have. Thank you.

A. That's just one example I have of the type of things that I would call mishandling.

Q. All right.

RECROSS-EXAMINATION

QUESTIONS BY MR. BOLZLE:

Q. Mr. Papageorge, if I could ask you a question, would your definition of mishandling also include a person that discharged industrial wastes in such a manner that they contaminate soil and ground water and surface water such that individuals not knowing of the

hazard could repeatedly come into contact with the PCBs?

MR. GOEBEL: I object to the form of the question. I'm not even sure I understand what he's asking.

Q. (By Mr. Bolzle) Did you understand my question, Mr. Papageorge?

A. I believe I do. Let me tell you what I understood. I understood you to say that this mishandling as it referred to the fact that soils are contaminated and individuals near the soil not knowing the contamination is present could be affected?

Q. Yes.

A. There again, you're asking me to speculate as to how does this contamination in the soil get into a person's lungs or on his skin in such quantities over a long enough period of time to create an obvious health symptom. I'm in no position to guess that.

Q. Let me -- let me approach the question from a different direction. Would you -- would your definition of mishandling include depositing industrial waste water which included PCBs into an unlined, leaking pond that contaminated both the ground water and the surface water?

MR. GOEBEL: Objection. There's no foundation in fact or evidence in this case to support the question, and I also object to the form for other reasons.

Q. (By Mr. Bolzle) You can go ahead and answer that question, Mr. Papageorge.

A. I would suggest that the condition that you just described for me is something that I would call, to use my earlier word, imprudent and just a wrong way to handle an industrial chemical, whether it be PCBs or any other.

Q. Mr. Papageorge, do you have any idea, by way of market share and so on, what the extent of the use of Pydraul was in the '60s and early '70s when it still contained PCBs? I mean, did it -- was Pydraul used -- was Pydraul used 90 percent of the time when hydraulic fluids were used? Do you have any figures in your mind like that?

A. I do not. All I know is that there were competitive products available. I have no idea of what proportion of the market the Pydraul products had.

Q. Do you have -- do you know whether -- or do you know the extent of industry knowledge in the '60s and '70s that Pydraul contained PCBs?

A. Well, certainly, they knew it in the '70s. I have no way of knowing how many knew exactly that the chlorinated hydrocarbon, as indicated on the label and in the literature, was a specific -- specifically a PCB.

Q. But referring to Exhibit 6 that you have

there, --

A. I have it.

Q. -- okay, sir, regardless of whether a consumer of Pydraul knew it contained PCBs, they would have known in the '60s that it contained chlorinated hydrocarbons and involved the hazards and the risks that were listed on these labels; would they not?

A. Yes.

Q. Okay. Thank you, sir.

MR. BOLZLE: No further questions.

MR. GOEBEL: Nothing for me.

MR. CUNNINGHAM: I think we've beaten this one to death just fine.

William B Papageorge

William B. Papageorge, P.E.

Subscribed and sworn to before me this 22nd day of October, 19 93.

My commission expires January 15, 19 95.

Josephine S. Niblock

[Notary Public.]

JOSEPHINE S. NIBLOCK
NOTARY PUBLIC STATE OF MISSOURI
ST. LOUIS COUNTY
MY COMMISSION EXP. JAN. 15,1995

NOTARIAL CERTIFICATE

STATE OF MISSOURI)
)
COUNTY OF ST. LOUIS)

I, TAMI L. BRUDER, a Registered Professional Reporter and a duly commissioned Notary Public within and for the State of Missouri, do hereby certify that on September 23, 1993, there came before me at the Marriott Hotel, Highway I-70 at Lambert International Airport, St. Louis, Missouri,

WILLIAM B. PAPAGEORGE, P.E.,

who was by me first duly sworn to testify to the truth and nothing but the truth of all knowledge touching and concerning the matters in controversy in this cause; that the witness was thereupon carefully examined under oath and said examination was reduced to writing by me; and that the signature of the witness is reserved by agreement of all parties, and that this deposition is a true and correct record of the testimony given by the witness.

I further certify that I am neither attorney nor counsel for nor related nor employed by any of the parties to the action in which this deposition is taken; further, that I am not a relative or employee of any attorney or counsel employed by the parties hereto or financially interested in this action.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 18th day of October, 1993.

My commission expires June 27, 1995.

Tami L. Bruder
[Notary Public]

Monsanto

ORGANIC CHEMICALS DIVISION

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

February 9, 1970

Dear Sir:

Recently several newspaper and magazine articles have been published indicating that Polychlorinated Biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million and parts per billion categories.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. Products which are sold by Monsanto under the trade names of Aroclor® 1254 and 1260 do contain chlorinated biphenyls. In addition to Aroclor® 1254 and 1260, Monsanto sells certain functional fluids containing Aroclor® 1254. These include Pydraul® 625, Pydraul® AC, Pydraul® AC - Winter Grade, Pydraul® 540, Therminol® FR-3 and certain dielectric formulations. Several other companies around the world also produce products containing chlorinated biphenyls.

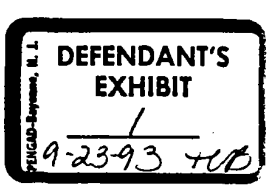
As your supplier of Aroclor® 1254 and 1260 and formulated products containing 1254, we wish to alert you to the potential problem of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts.

1. Products such as Pydraul® 90, 135, 230, 312, A-200, F-9, 150 and 60, Turbinol® 153 and Therminol® FR-1 and FR-2 are not formulated with Aroclor® 1254 or 1260.

2. PCBs with a chlorine content of less than 54% have not been found in the environment and appear to present no potential problem to the environment.

ROCW 00059



We have developed, and are now testing, new formulations to replace the Aroclor® 1254 and 1260 components in our Pydraul® products. The new products appear to be equal in performance and to have similar physical properties.

We feel that all possible care should be taken in the application, processing and effluent disposal of these products to prevent them becoming environmental contaminants. Of interest to you may be an article in Chemical Week, October 29, 1969 regarding water pollution standards set by each state in the Union. It is attached. This article reflects that good manufacturing practice in the future may require that no products used by any company should find their way into waterways.

Sincerely yours,

Donald A. Olson
Director of Sales
Functional Fluids Group

nlc
Attachment

ROCW 00060

Environment

The huge water requirements of the chemical industry—now the nation's third largest user—make water quality and availability increasingly important factors for site selectors. Legislation enacted in recent years has forced planners to pay close attention to pollution control standards.

All 50 states have had their water quality standards approved entirely or in part by the Federal Water Pollution Control Administration (FWPCA). Recently a state-by-state summary of key standards was put together for the first time. Surprisingly, it was not the FWPCA that did the job. Instead it was handled by an American Public Health Assn. (APHA) subcommittee headed by TVA Health Director F. E. Gartrell, assisted by the APHA Engineering and Sanitation Section. A portion of the study, covering standards for surface industrial water, is summarized in the tables starting on p. 80.

Contrary to widely held opinions, there is considerable variation in state standards. Take the dissolved oxygen (DO) standard, for example. Minimum allowable DO (as milligrams per liter or percent saturation) is the single most important standard to chemical site evaluators. As a rough rule of thumb, a 2-mg./l. standard is considered to be one industry can live with comfortably, while a 6.0 mg./l. value is pegged "extremely tough."

California, Wyoming and Washington have set the standard at 6 mg./l. or higher. But a few states such as Connecticut, Maine, Illinois, Indiana, Massachusetts, Virginia and Wisconsin require 2 mg./l. or lower.

Other standards—notably turbidity, taste, odor, color and solids—may also be important, depending upon the nature of the chemical plant's waste effluents. These standards also exhibit state-by-state differences. Moreover, they are generally less specific than the straight numerical DO standards.

Although chemical plant site experts see little point in "running from tough standards," the criteria do make a difference: Plans for two nonferrous metals plants in Puerto Rico are now on the shelf, because of standards that call for a 4.5 mg./l. DO, no wastes that interfere with the esthetics of the waters and other specifications.

No compilation of ground water standards has yet been published. Ground water standards may prove important in the future as companies are forced to use costly deep-well disposal for wastes. Availability of ocean waste disposal services is also looming more important.

Waste Cost: The price tag for pollution control is high. A recent FWPCA study on the organic chemicals industry estimated that water waste-treatment facilities can increase installed capital equipment costs 40% or more. Between '69-'73, the organic chemical industry would have to shell out $182.5 million to remove 10% of its biological and chemical oxygen demand waste and 65% of its suspended solids. Removal levels of 83%, 13% and 71%, respectively, for biologic oxygen demand, chemical oxygen demand and suspended solids would require $242.6 million, while 98%, 30% and 89%, respecuvely, would up the ante to $608 million.

Cleaner Air: Establishment of air quality standards is not nearly as far advanced as are water standards. The National Air Pollution Control Administraion (NAPCA) is still designating regional air control regions. At last count, 16 regions had been formally designated and another 41 had been proposed. NAPCA has issued air quality criteria and control technology data for sulfur oxides and particulate matter and follow with similar studies for other pollutants.

Once criteria and control data have been issued for a pollutant and control regions have been designated a long process involving standards hearings and implementation and enforcement plans will be initiated that can take over a year to produce standards.

So far, no firm sulfur oxide or particulate standards have emerged. But NAPCA's criteria for setting the standards suggest they'll be tough. The oxide criteria report, for example, emphasizes that there are deleterious effects to man at concentrations as low as 0.04 ppm.

NAPCA's control data reports present detailed appraisals of various methods and equipment, along with estimated costs. As in the case of water, the costs will be high, although some pollutants—mainly sulfur dioxide—will have recovery values. NAPCA is sponsoring a number of research projects to improve technology. Pollution control is being spurred by financial assistance programs mandated by state laws now operative in the following 28 states:

Arizona, Arkansas, California, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Maine, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, Washington, Wisconsin and West Virginia.

In addition, Pennsylvania offers financial aid sanctioned by administrative regulation. Several states, including Utah and Maryland have legislative studies under way.

The incentives take a variety of forms. Most common are exemption from personal property taxes (e.g., Arkansas), fast depreciation (Arizona), exemption from ad valorem equipment and structures taxes (Connecticut), exemption from local taxes for stated period of time (New Hampshire), operating loss deductions (New York); credit against state income tax (Oregon).

Quantity: The large chemical complexes now in vogue make water—and lots of it—a major site criterion. The cooler the water is, the better, for it can reduce the investment in heat-exchange equipment. Occasionally, plants can manage on ground water, but usually surface water is required. That means location on or near the big, drought-resistant rivers. There are less than 200 rivers in the U. S. with minimum flows over 50 cu. ft. per second (*CW Oct. 5, '68, pp. 44-46*). For companies whose plant needs at least 100 cu. ft. second, the list numbers only 150 (excluding Alaska). Sea water is generally avoided because of high equipment corrosion costs.

Piping water in is expensive. Duval, now opening a 3.5 million tons/year sulfur mine in the arid Northwest area, was forced to install a 36-in., 38-mile-long water line and a 4-million-gal. reservoir. Cost of the water supply system hasn't been disclosed, but it is estimated that the tab was at least several million dollars.

The adequacy of domestic water resources in the near [illegible] has recently been evaluated by the Geological Survey. Nationally, projected demand will be 173% of potentially assured supply. Only in three regions, New England, Ohio and the South Atlantic Eastern Gulf, will future water requirements be easily met. Economic growth may be handicapped in nine regions. Eastern Great Lakes, Lower Mississippi, Upper Missouri-Hudson Bay, Lower Missouri, Western Gulf-Rio Grande, Pecos, Colorado, Great Basin, and Central and South Pacific.

For the first time, a summary of water quality standards set by all 50 states.

	pH Allowable		Temperature (°F) allowable		Dissolved oxygen	Other Requirements
	Range	Deviation	Maximum	Increase above ambient	(minimum, mg./L. or %)	
Alabama	6.0–8.5	1.0	90° (24 hrs.) 93° (any 8 hrs.) 93° (cooling water)	10% — 10°	2.0 at 5 ft. or middepth if less than 10 ft.	**Radioactivity, Color, Taste and Odor, Toxic Substances:** Only in amounts that would not render waters unsuitable for industrial-cooling and process-water supply purposes. **Solids:** Free from waste materials that cause unsightly or putrescent conditions or interfere directly or indirectly with industrial use.
Alaska	7.0–8.0	0.5	70°	—	5.0	**Radioactivity:** Not to exceed limits of PHS Drinking Water Standards. **Turbidity:** No imposed values that would interfere with established levels of treatment. **Color:** True color less than 50 color units. **Taste and Odor:** Shall not unreasonably impair esthetic considerations. **Solids:** No dissolved solids above natural conditions causing corrosion or scaling problems. No visible evidence of other floating solids or sludge deposits. No imposed sediment loads that would interfere with established treatment levels.* **Toxic Substances:** Chemical constituents should be below concentrations found to be of public health significance.*
Arizona	6.5–8.6	0.5	93°	5°	—	**Radioactivity:** Not to exceed 1/30 of the MPC$_e$ value given for continuous occupational exposure in NBS Handbook 69. **Turbidity:** 50 JCU (streams); 25 JCU (lakes). **Color:** Free from waste materials in amounts sufficient to change existing color enough to interfere with industrial use or to create a nuisance. **Taste and Odor:** Free from wastes in amounts sufficient to produce enough taste and odor to create a nuisance or interfere with industrial use. **Solids:** Free from wastes that would be unsightly, putrescent, odorous or in amounts that would interfere with industrial use. **Toxic Substances:** Free from wastes toxic to human, animal, plant or aquatic life or in amounts that would interfere with industrial use.
Arkansas	6.0–9.0	1.0 (24 hrs.)	95°	5°	4.0 (average for any cross section)	**Radioactivity:** "Rules and Regulations for the Control of Ionizing Radiation," Arkansas Board of Health, apply. **Turbidity:** No distinctly visible increases due to wastes. **Color:** Shall not be increased to the extent that it interferes with industrial use, present or future. **Taste and Odor:** Must not cause offensive odors or otherwise interfere with industrial use. **Solids:** No distinctly visible persistent solids, bottom deposits or sludge banks due to wastes. **Toxic Substances:** Must not be present in amounts toxic to human, animal, plant or aquatic life.
California	6.5–8.6 7.0–8.6 (Coastal waters)	—	71.6°* (fresh water)	None that would cause ecological change or harm aquatic life (coastal waters)*	6.0 Coastal water: 5.0 (unless naturally lower)	**Radioactivity:** Shall not exceed 1/10 of the MPC$_e$ values given for continuous occupational exposure in NBS Handbook 69. **Turbidity:** Free from wastes that could alter water's existing turbidity. **Color:** Free from substances attributable to wastes that produce detrimental color. **Taste and Odor:** No substances that impart foreign taste or odor. **Solids:** Dissolved solids in fresh water must not exceed 300 mg./l. at any time; annual mean: 175 mg./l. Settleable solids must not be able to change nature of stream bottom or harm aquatic environment. **Toxic Substances:** At all times free from concentrations harmful to humans, aquatic life or wild or domestic animals.
Colorado	5.0–9.0	—	93°	—	3.0	**Radioactivity:** Not to exceed 1/30 of the 168-hr./week values in NBS Handbook 69. **Turbidity:** Must not interfere with established levels of treatment. **Color:** Wastes present must not cause appreciable change in color or interfere with industrial use. **Taste and Odor:** Free from wastes that cause odor or appreciable change in taste. **Solids:** Free from wastes that are unsightly, putrescent or odorous or would interfere with use. **Toxic Substances:** Free from wastes in concentrations or combinations sufficient to harm human or animal life.
Connecticut	6.0–9.0	—	—	None unless it does not exceed recommended limits for industrial use	2.0	**Radioactivity:** Limits to be approved by appropriate state agency. **Turbidity, Color, Taste and Odor:** None in such quantities that would impair industrial use. **Solids:** Limited to small amounts that may result from discharge of appropriately treated wastes. **Toxic Substances:** Free from chemical constituents in concentrations or combinations harmful to human, animal or aquatic life.
Delaware	6.5–8.5	—	—	5°	50%* or 4.0	**Radioactivity:** Alpha emitters limited to 3 pc/l.; beta emitters, to 1,000 pc/l. **Color, Taste and Odor:** None in concentrations that cause color, taste or odor. **Solids:** Free from unsightly and malodorous nuisances due to floating solids or sludge deposits. **Toxic Substances:** None in concentrations harmful (synergistically or otherwise) to humans, fish, shellfish, wildlife or aquatic life.
Florida	6.0–8.5	1.0	—	—	4.0	**Radiation:** Gross beta—1,000 pc/l. (In absence of Sr-90 and alpha emitters). **Turbidity:** 50 JCU. **Color:** Must not render water unfit for industrial-cooling or process-water supply purposes. **Taste:** Must not render water unfit for industrial use; phenols 0.001 maximum. **Solids:** Dissolved solids must not exceed 1,000 mg./l.; monthly average: 500 mg./l. Must be free from floating wastes that are unsightly or deleterious or other wastes that settle to form putrescent or objectionable sludge deposits. **Toxic Substances:** Free from wastes harmful to human, animal or aquatic life. Cu, 0.5 mg./l.; Zn, 1.0; Cr, 0.05; Pb, 0.05; Fe, 0.3; As, 0.05; F, 10.0; Cn, none detectable.

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above ambient	Dissolved oxygen (minimum mg./L. or %)	Other Requirements
Georgia	6.0-8.5	—	90.2°	10° (above natural)	2.5 5.0 (daily average)	Radioactivity: Must conform to state statutes. Turbidity, Color, Taste and Odor: Free from wastes that cause objectionable conditions or interfere with industrial use. Solids: Free from wastes that are unsightly, putrescent or otherwise objectionable or would interfere with industrial use. Toxic Substances: No wastes in concentrations that would prevent fish survival or interfere with industrial use.
Hawaii	6.5-8.5	—	—	—	4.6	Radioactivity: Not to exceed 1/30 of the values given by NBS Handbook 69. Turbidity: Free from soil particles from erosion caused by land development or agricultural use. Taste and Odor: Wastes, after dilution and mixture, must not interfere with industrial use. Toxic Substances: Free from substances in concentrations harmful to human, animal, or marine life or that make waters unsuitable for industrial use.
Idaho	6.5-8.5	0.5	—	2° Only if water 68° or less	75% (of saturation normal low)	Radioactivity: Not to exceed limits of '62 PHS Drinking Water Standards. Turbidity: No objectionable turbidity that can be traced to a point source. Solids: No floating or submerged matter no sludge deposits that could adversely affect industrial use. Toxic Substances: No wastes of other than natural origin in concentrations of public health significance or that could adversely affect industrial use.
Illinois	6.0-8.5	—	90°	—	2.0 3.0 (for 16 hrs. in any 24-hr. period)	Color, Taste and Odor: Free from wastes that produce color, odor or taste in such a degree as to create a nuisance. Solids: Free from floating wastes that settle and form unsightly, deleterious or putrescent deposits. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Indiana	6.0-8.5	—	90°	—	1.0 2.0 (daily average)	Color, Taste and Odor: Free from wastes that produce color, taste or odor in such a degree as to create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; monthly average, 750 mg./l. Must be free from unsightly, putrescent, deleterious or otherwise objectionable wastes. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Iowa	—	—	—	—	—	Color, Taste and Odor: Free from wastes that produce color, taste or odor in such a degree as to be detrimental to industrial use. Solids: Free from floating wastes in amounts that would be unsightly or deleterious or other wastes that settle to form putrescent or objectionable sludge deposits. Toxic Substances: No wastes in concentrations or combinations detrimental to human, animal or aquatic life or to industrial use.
Kansas	6.5-9.0	—	90°	—	4.0°	Turbidity: No increase that causes substantial visible contrast with natural appearance or that is detrimental to industrial use. Color: Discharges of color-producing substances limited to concentrations not detrimental to industrial use. Taste and Odor: Concentrations limited to those that would not result in noticeable offensive odors or otherwise interfere with industrial use. Solids: Free from floating debris or material in amounts that would be unsightly or detrimental to industrial use. Toxic Substances: Pollutional substances must be maintained below concentrations detrimental for industrial use.
Kentucky	5.0-9.0	—	90° 75° (Dam-Falls)	2°/hr 10°/day	—	Color, Taste and Odor: Wastes must not create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; monthly average, 750 mg./l. No floating wastes in unsightly or deleterious amounts; no other wastes that settle to form putrescent or objectionable sludges. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Louisiana	6.0-8.5	—	94.5°	5.4°	50%	Radioactivity: Specific limits set for all radioactive isotopes released as waste. Solids: None that would produce floating masses, sludge banks or beds on bottom, either organic or inorganic. Toxic Substances: No wastes in concentrations or combinations harmful to animal or plant life.
Maine	6.0-8.0*	0.2*	90°*	—	2.0*	Radioactivity: Not to exceed '62 PHS Drinking Water Standards. Turbidity, Color, Taste and Odor: Free from wastes that impart turbidity, color, taste or odor or impair industrial use. Solids: Free from sludge deposits, solid refuse and floating solids. Toxic Substances: No chemical constituents from waste sources harmful to humans or that adversely affect industrial use.
Maryland	6.0-8.5* (ambient, naturally)	—	100°	—	4.0 (unless naturally lower)	Color, Taste and Odor: Free from waste materials that change existing color or produce taste and odor to such a degree as to create a nuisance or interfere with industrial use. Solids: Free from wastes that float, settle to form deposits, create a nuisance or interfere with industrial use and are unsightly, putrescent or odorous. Toxic Substances: Free from toxic wastes that interfere with industrial use or that are harmful to human, plant, animal or aquatic life.
Massachusetts	6.0-8.5		90°	—	2.0	Radioactivity: None in concentrations harmful to human, animal or aquatic life. Turbidity, Color, Taste and Odor: None in concentrations that would impair industrial use. Solids: None allowed except that which may result from the discharge from waste-treatment facilities providing appropriate treatment. Toxic Substances: None in concentrations or combinations harmful to human, animal or aquatic life.

Water quality standards

	pH Allowable		Temperature (°F) allowable		Dissolved oxygen	Other Requirements
	Range	Deviation	Maximum	Increase above ambient	(minimum mg./l. or %)	
Michigan	6.5–8.5	0.5	—	10°	Enough to prevent nuisance	Radioactivity: Standards to be established when information is available on deleterious effects. Turbidity, Color: No objectionable unnatural turbidity or color in quantities sufficient to interfere with industrial use. Taste and Odor: Below levels that are or may become injurious to industrial use. Solids: Dissolved solids must not exceed 750 mg./l.; monthly average: 500 mg./l. No floating solids or objectionable deposits in quantities that would interfere with industrial use. Toxic Substances: Limited to concentrations less than those that are or may become injurious to this use.
Minnesota	6.0–9.0	—	86°	—	—	Color, Taste and Odor, Solids: Free from wastes that cause nuisance conditions, such as material discoloration, obnoxious odors, significant floating solids, excessive suspended solids or sludge deposits.
Mississippi	6.0–8.5	1.0	93°	10°	3.0	Color, Taste and Odor: Free from wastes that produce color or odor in such degree as to create a nuisance. Solids: Dissolved solids must not exceed 1,500 mg./l.; monthly average 750 mg./l. Must be free from floating wastes that settle to form unsightly, deleterious, objectionable or putrescent deposits. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal or aquatic life.
Missouri	6.5–9.0	—	90°	5° (average of cross section)	4.0*	Radioactivity: Gross beta: 1,000 pc/l. (in absence of Sr-90 and alpha emitters). Sr-90: 10 pc/l. Dissolved Ra-226: 3 pc/l. Color: Wastes must not cause substantial visible contrast with natural appearance of stream or interfere with industrial use. Taste and Odor: Limited to concentrations that would not result in noticeable offensive odors or otherwise interfere with industrial use. Solids: No noticeable organic or inorganic deposits or floating materials in unsightly or deleterious amounts. Toxic Substances: Concentrations not detrimental to industrial use or toxic to humans, fish, wildlife. P:1.2.
Montana	6.5–9.5	0.5	—	No adverse change	—	Radioactivity: Not to exceed '62 PHS Drinking Water Standards. Turbidity: Must not interfere with established levels of treatment. Color, Taste and Odor: Water shall be maintained in condition not offensive to sense of sight or smell. Solids: No floating solids and sludge deposits in amounts deleterious to industrial use; no sediments or settleable solids that affect treatment levels. Toxic Substances: Amounts present must not adversely affect industrial use.
Nebraska	6.5–9.0	1.0	90°	5° (May-Oct.) 10° (Nov.-Apr.) Rate: 2°/hr.	5.0	Radioactivity: Must conform with Radiological Health Regulations (1st. ed.), State of Nebraska, '66. Turbidity: No more than 10% increase above normal level. Color: No evidence of matter that creates nuisance conditions. Taste and Odor: Less than amounts that would degrade water quality for industrial use; phenol: 0.001 mg./l. Solids: Dissolved solids must not exceed 1,500 mg./l. No more than 20% increase (limit 100 mg./l.) from any point source. No waste solids that permit deposition or are deleterious to industrial use. Toxic Substances: None in concentrations or combinations that would render water unsuitable for industrial use.
Nevada	6.5–8.5 Annual median: 7.4–8.3	—	77.0° (summer) 57.2° (winter)	—	5.0 6.0 (average, June–Sept.)	Radioactivity: Limited to 1/10 of the 168-hr.-week values in NBS Handbook 69. Turbidity, Color, Taste and Odor: Free from wastes in amounts sufficient to change existing turbidity or color enough to create a nuisance or interfere with industrial use, or to produce taste or odor in the water. Solids: Free from floating or other wastes that settle to form sludge banks or deposits in amounts that would be unsightly or odorous or interfere with industrial use. Toxic Substances: Free from wastes in concentrations or combinations toxic to human, animal, plant or aquatic life or that interfere with industrial use.
New Hampshire	6.0–8.5 (unless natural)	—	90°*	No increase that would interfere with this use*	5.0	Turbidity, Color, Taste and Odor: None in objectionable amounts. Solids: No floating solids or sludge deposits in objectionable amounts. Toxic Substances: None in toxic concentrations or combinations.
New Jersey	6.5–8.5 (unless natural)	—	87° (unless natural)	5° (up to 87°)	4.0*	Turbidity, Solids: None noticeable in water or deposited along shore. Color, Taste and Odor: None that are offensive to humans or detrimental to aquatic biota. Toxic Substances: None that would affect humans or be detrimental to aquatic biota.
New Mexico	6.6–8.6	—	—	Must not pollute or make water unfit for this use	No oxygen demand that would cause pollution	Radioactivity: Not greater than 1/10 of the 48-hr. value in NBS Handbook 69. Turbidity: Shall not cause substantial visible contrast with natural appearance. Color: Should not create an esthetically undesirable condition. Taste and Odor: No odors, other than of natural origin, that are esthetically objectionable or abnormal. Solids: No objectionable floating solids or debris and sediment that significantly alter properties of bottom. Toxic Substances: No amounts toxic to humans, plants, fish, animals.
New York	6.0–8.5	—	86°	5° (average 7 days) Rate: 2°/hr. 9°/24 hrs.	3.0	Color: No colored wastes that alone or in combinations make water unsuitable for industrial use. Solids: No floating or settleable solids or sludge deposits that are readily visible and attributable to wastes. Toxic Substances: None alone or in combinations that would impair industrial use.

Water quality standards

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above ambient	Dissolved oxygen (minimum) mg./L. or %	Other Requirements
North Carolina	Normal for area, usually 6.0-8.5 or less as a result of swamps	—	90°	7°	3.0	Color: Must not render water unfit for industrial cooling. Solids: Must not, after dilution and mixture, make water unfit for industrial cooling. Toxic Substances: Must not make water unfit for industrial cooling.
North Dakota	6.0-8.5	0.5	90°	10°	3.0 5.0 (for 16 hrs./day)	Radioactivity: No discharge allowed unless materials are readily soluble or dispersible and of quantities acceptable to state health department. Color, Taste and Odor: No wastes that color water or result in objectionable odors to a degree that impairs industrial use. Solids: No unsightly floating wastes that would adversely affect industrial use or wastes that settle to form putrescent or objectionable deposits. Toxic Substances: No concentrations or combinations harmful to human, animal or aquatic life.
Ohio	6.0-8.0	—	90°	—	1.0 2.0 (daily average)	Color, Taste and Odor: Free from wastes that produce color or odor to a degree that creates a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./L.; monthly average: 750 mg./L. Must be free from floating or other wastes that settle to form putrescent or objectionable deposits or that are unsightly or deleterious. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal or aquatic life.
Oklahoma	6.5-8.5	—	90°	5°	4.0	Radioactivity: Average concentration at points of controlled release shall not exceed State Board of Health Radiation Protection Regulations. Turbidity: None that causes visible contrast with natural conditions. Color: None that is persistent in concentrations detrimental to industrial use. Taste and Odor: No concentrations that would cause offensive odors in vicinity of water or otherwise interfere with industrial use. Solids: Free from floating debris, bottom deposits or other materials. Toxic Substances: None in quantities that make water toxic to human, animal, plant or aquatic life.
Oregon	6.5-8.5	—	—	2° (only if water 70° or less)	5.0	Radiation: Shall not pose external hazard. Turbidity: 5 JCU above natural. Color, Taste and Odor: No objectionable discoloration or conditions esthetically offensive to human senses of taste or smell. Solids: No floating solids, organic or inorganic deposits injurious to industry. Toxic Substances: No conditions injurious to public health.
Pennsylvania	6.0-9.0	—	93°	2°/hr.	4.0 5.0 (daily average)	Color, Taste and Odor: No wastes that produce colors, tastes or odors in amounts harmful to industrial use. Solids: Dissolved solids must not exceed 750 mg./L.; monthly average: 500 mg./L. No floating wastes or substances that settle to form sludge in amounts harmful to industrial use. Toxic Substances: None in amounts harmful to industrial use.
Rhode Island	6.0-8.5	—	—	4°	3.0° 5.0° (16 hrs./day)	Radioactivity, Toxic Substances: No concentrations or combinations harmful to human, animal or aquatic life. Turbidity, Taste and Odor: None in concentrations that would impair industrial use. Solids: No solid refuse, floating solids or sludge deposits.
South Carolina	6.0-8.5 5.0-8.5 (swamps)	—	93.2°°	10°°	3.0° 2.5° (swamps)	Turbidity, Color, Taste and Odor: Free from wastes that change the existing turbidity or color or that produce taste or odor to such a degree as to cause a nuisance or interfere with industrial use. Solids: None from waste sources in amounts that are unsightly, putrescent, odorous or that cause a nuisance or interfere with industrial use. Toxic Substances: Free from wastes harmful to human, animal, plant or aquatic life or that interfere directly or indirectly with industrial use.
South Dakota	6.0-8.5	1.0	—	—	—	Radioactivity: None permitted in water unless readily soluble or dispersible and in quantities allowed by federal or state agencies. Color, Taste and Odor: No wastes that produce material discoloration or undesirable odors. Solids: Dissolved solids must not exceed 2,000 mg./L. No wastes producing floating solids, sludge deposits or other offensive effects. Toxic Substances: None in concentrations toxic to human, animal or aquatic life.
Tennessee	6.0-8.0	1.0 (25% limit)	90°	10° Rate: 3°/hr.	Enough to prevent offensive conditions	Radioactivity: None that could adversely affect industrial use. Turbidity, Color: None in amounts or concentrations that could not be reduced to acceptable levels by conventional treatment. Taste and Odor: None that would result in taste or odor that would prevent use for industrial processing. Solids: Dissolved solids must not exceed 500 mg./L. No distinctly visible solids, bottom deposits or sludge banks that could be detrimental to industrial use. Toxic Substances: None that produces toxic conditions that would adversely affect water for industrial use.
Texas	6.0-8.5 5.0-9.0 (cooling water)	—	—	—	4.0	Radioactivity: Regulated by Texas Radiation Control Act and Texas Regulations for Control of Radiation. Turbidity: No substantial increase due to wastes. Color: No substantial visible contrast with natural appearance of receiving waters after wastes receive best practical treatment. Taste and Odor: No concentrations that produce offensive odors. Solids: Dissolved solids must not exceed 1,000 mg./L., unless water used only for cooling. Must be essentially free from floating or settleable suspended solids that would adversely affect industrial use. Toxic Substances: Shall not show acute or chronic toxicity to humans, animals or aquatic life to such an extent as to interfere with industrial use.

Water quality standards

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above ambient	Dissolved oxygen (minimum mg./l. or %)	Other Requirements
Utah	6.5–9.0	—	—	—	—	Radioactivity: Shall not exceed 1/30 of MPC$_w$ values for continuous occupational exposure in NBS Handbook 69. Turbidity, Color: No wastes in amounts that would change existing turbidity or color enough to create public nuisance or interfere with industrial use. Taste and Odor: No wastes in amounts that would produce taste or odor. Solids: No floating wastes that are unsightly or that interfere with industrial use; no wastes that settle to form unsightly or odorous sludge or bottom deposits. Toxic Substances: No wastes in concentrations or combinations toxic to human, animal, plant or aquatic life or that would interfere with industrial use.
Vermont	6.0–8.5	—	—	4°	3.0* 5.0* (16 hrs./day)	Radioactivity: To be approved by appropriate state agency. Turbidity, Color, Taste and Odor: None in concentrations that would impair industrial use. Solids: No floating solids, sludge deposits or solid refuse. Toxic Substances: No chemical constituents in concentrations or combinations harmful to human, animal or aquatic life.
Virginia	5.0–9.0 (swamps as low as 4.3)	—	93°* (unless naturally higher)	No sudden changes that could harm aquatic life	1.0* 2.0* (daily average)	Color, Taste and Odor: No wastes that change existing color or produce odor to such a degree as to create a nuisance or interfere with industrial use. Solids: No floating wastes that are unsightly or create a nuisance or other wastes that settle to form unsightly, putrescent or odorous deposits. Toxic Substances: No wastes in concentrations or combinations that would interfere directly or indirectly with industrial use.
Washington	6.5–8.5	0.5	70°	t = 110/(T+15)††	6.5 or 70%	Radioactivity, Toxic Substances: Below concentrations that could adversely affect industrial use. Turbidity: Less than 10 JCU over natural conditions. Color, Taste and Odor, Solids: Dissolved, suspended, floating or submerged matter shall not reduce esthetic values so as to affect industrial use.
West Virginia	Process water: 6.5–9.0 Cooling water: 5.0–9.0	—	Cooling water: 93° (May-Nov.) 73° (Dec.-Apr.) Process water must permit fish passage	5° Rate: 2°/hr. (Dec.-Apr.)	1.0 2.0 (daily average)	Color: None that is objectionable. Taste and Odor: No objectionable odors in vicinity of the water. Solids: No distinctly visible floating, settleable or suspended solids of unreasonable kind or quantity. No objectionable bottom deposits or sludge banks. Toxic Substances: No concentrations of materials poisonous to human, animal or fish life.
Wisconsin	6.0–9.0	0.5	89°	—	1.0 2.0 (daily average)	Color, Taste and Odor: No materials producing color, taste or odor in amounts that would create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; daily average: 750 mg./l. No floating or submerged debris or waste substances that would cause objectionable deposits in amounts to create a nuisance. Toxic Substances: None in concentrations or combinations toxic to humans or of public health significance.
Wyoming	6.5–8.5	—	—	4° 2° (for streams where temp. not over 70°)	6.0	Radioactivity: Not to exceed 1/30 of NBS Handbook 69 values. Turbidity: No more than 15 JCU above natural (when turbidity is 150 JCU or less); otherwise, no more than 10% above natural. Color: Essentially free of wastes that visibly alter natural color of water or impart color to vessels or structures. Taste and Odor: Essentially free from substances that would produce detectable odor at site of use. Solids: Essentially free from floating or settleable solids that are unsightly or settle to form sludge, bank or bottom deposits. Toxic Substances: Free from toxic substances in concentrations or combinations toxic to human, animal or aquatic life.

* Standard reserved from Federal Water Pollution Control Administration approval.
†† t = total cumulative heat addition allowed from unnatural waste sources, at any point throughout the given stream reach. T = highest occurring temperature for a given period, in a specific stream reach.
Abbreviations: PHS—Public Health Service; NBS—National Bureau of Standards; JCU—Jackson Candle Units; pc/l.—picocuries per liter.
Source: Water Quality Standards of the United States, Territories, and the District of Columbia, American Public Health Assn., Subcommittee on Water Quality Control, and Engineering and Sanitation Section.
Note: Specific limits for coliforms, biologic oxygen demand, plant nutrients, oil, grease, scum, bottom deposits, pesticides, specific conductance, carbon chloroform extract, synthetic detergents not included. Some states set standards for each stream reach or river basin; in such cases, table shows least stringent requirement.

This reprint is an excerpt from the "Plant Sites, '69" report
that appeared in the October 29, 1969 issue of CHEMICAL WEEK

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

Dear Customer:

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 tradenames of Aroclor® 1254 and 1260 contain chlorinated biphenyls.

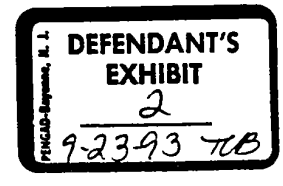
As your supplier of Aroclor® 1254 and 1260, we wish to alert you to the potential problem of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts.

1. Certain Monsanto products which are sold under the Aroclor® trademark, namely Aroclor® 5060, 5442 and 5460, are not polychlorinated biphenyls.

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.

ROCW 00050



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 the view that good manufacturing practice in the future may require that no products used by any company be lost or discharged in such a manner as to ultimately be found in waterways.

Very truly yours,

W. E. Schalk
Director of Sales
Plasticizers

ek

Environment

The huge water requirements of the chemical industry—now the nation's third largest user—make water quality and availability increasingly important factors for site selectors. Legislation enacted in recent years has forced planners to pay close attention to pollution control standards.

All 50 states have had their water quality standards approved entirely or in part by the Federal Water Pollution Control Administration (FWPCA). Recently a state-by-state summary of key standards was put together for the first time. Surprisingly, it was not the FWPCA that did the job. Instead it was handled by an American Public Health Assn. (APHA) subcommittee headed by TVA Health Director F. E. Gartrell, assisted by the APHA Engineering and Sanitation Section. A portion of the study, covering standards for surface industrial water, is summarized in the tables starting on p. 80.

Contrary to widely held opinions, there is considerable variation in state standards. Take the dissolved oxygen (DO) standard, for example. Minimum allowable DO (as milligrams per liter or percent saturation) is the single most important standard to chemical site evaluators. As a rough rule of thumb, a 2-mg./l. standard is considered to be one industry can live with comfortably, while a 6.0 mg./l. value is pegged "extremely tough."

California, Wyoming and Washington have set the standard at 6 mg./l. or higher. But a few states such as Connecticut, Maine, Illinois, Indiana, Massachusetts, Virginia and Wisconsin require 2 mg./l. or lower.

Other standards—notably turbidity, taste, odor, color and solids—may also be important, depending upon the nature of the chemical plant's waste effluents. These standards also exhibit state-by-state differences. Moreover, they are generally less specific than the straight numerical DO standards.

Although chemical plant site experts see little point in "running from tough standards," the criteria do make a difference: Plans for two nonferrous metals plants in Puerto Rico are now on the shelf, because of standards that call for a 4.5 mg./l. DO, no wastes that interfere with the esthetics of the waters and other specifications.

No compilation of ground water standards has yet been published. Ground water standards may prove important in the future as companies are forced to use costly deep-well disposal for wastes. Availability of ocean waste disposal services is also looming more important.

Waste Cost: The price tag for pollution control is high. A recent FWPCA study on the organic chemicals industry estimated that water waste-treatment facilities can increase installed capital equipment costs 40% or more. Between '69-'73, the organic chemical industry would have to shell out $182.5 million to remove 10% of its biological and chemical oxygen demand waste and 65% of its suspended solids. Removal levels of 83%, 13% and 71%, respectively, for biologic oxygen demand, chemical oxygen demand and suspended solids would require $242.6 million, while 98%, 30% and 89%, respectively, would up the ante to $608 million.

Cleaner Air: Establishment of air quality standards is not nearly as far advanced as are water standards. The National Air Pollution Control Administration (NAPCA) is still designating regional air control regions. At last count, 16 regions had been formally designated and another 41 had been proposed. NAPCA has issued air quality criteria and control technology data for sulfur oxides and particulate matter, will follow with similar studies for other pollutants.

Once criteria and control data have been issued for a pollutant and control regions have been designated, a complicated process involving standards, hearings and implementation and enforcement plans will be initiated that can take over a year to produce standards.

So far, no firm sulfur oxide or particulate standards have emerged. But NAPCA's criteria for setting the standards suggest they'll be tough. The oxide criteria report, for example, emphasizes that there are deleterious effects to man at concentrations as low as 0.04 ppm.

NAPCA's control data reports present detailed appraisals of various methods and equipment, along with estimated costs. As in the case of water, the costs will be high, although some pollutants—mainly sulfur dioxide—will have recovery values. NAPCA is sponsoring a number of research projects to improve technology. Pollution control is being spurred by financial assistance programs (mandated by state law) now operative in the following 28 states:

Arizona, Arkansas, California, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Maine, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, Washington, Wisconsin and West Virginia.

In addition, Pennsylvania offers financial aid sanctioned by administrative regulation. Several states, including Utah and Maryland have legislative studies under way.

The incentives take a variety of forms. Most common are exemption from personal property taxes (e.g., Arkansas), fast depreciation (Arizona), exemption from ad valorem equipment and structures taxes (Connecticut), exemption from local taxes for stated period of time (New Hampshire), operating loss deductions (New York); credit against state income tax (Oregon).

Quantity: The large chemical complexes now in vogue make water—and lots of it—a major site criterion. The cooler the water is, the better, for it can reduce the investment in heat-exchange equipment. Occasionally, plants can manage on ground water, but usually surface water is required. That means location on or near the big, drought-resistant rivers. There are less than 200 rivers in the U. S. with minimum flows over 50 cu. ft. per second *(CW Oct. 5, '68, pp. 94-95)*. For companies whose plant needs at least 100 cu. ft/second, the list numbers only 150 (excluding Alaska). Sea water is generally avoided because of high equipment corrosion costs.

Piping water in is expensive. Duval, now opening a 1.5 million tons/year sulfur mine in the arid Northwest area, was forced to install a 36-in., 38-mile-long water line and a 40-million-gal. reservoir. Cost of the water supply system hasn't been disclosed, but it is estimated that the tab was at least several million dollars.

The adequacy of domestic water resources in the year 2000 has recently been evaluated by the Geological Survey. Nationally, projected demand will be 173% of potentially assured supply. Only in three regions, New England, Ohio, and the South Atlantic Eastern Gulf, will future water requirements be easily met. Economic growth may be handicapped in nine regions: Eastern Great Lakes, Lower Mississippi, Upper Missouri-Hudson Bay, Lower Missouri, Western Gulf—Rio Grande, Pecos, Colorado, Great Basin, and Central and South Pacific.

For the first time, a summary of water quality standards by all 50 states.

	pH Allowable		Temperature (°F) allowable		Dissolved oxygen	Other Requirements
	Range	Deviation	Maximum	Increase above ambient	(minimum, mg./l. or %)	
Alabama	6.0–8.5	1.0	90° (24 hrs.) 93° (any 8 hrs.) 93° (cooling water)	10% — 10°	2.0 at 5 ft. or middepth if less than 10 ft.	**Radioactivity, Color, Taste and Odor, Toxic Substances:** Only in amounts that would not render waters unsuitable for industrial-cooling and process-water supply purposes. **Solids:** Free from waste materials that cause unsightly or putrescent conditions or interfere directly or indirectly with industrial use.
Alaska	7.0–8.0	0.5	70°	—	5.0	**Radioactivity:** Not to exceed limits of PHS Drinking Water Standards. **Turbidity:** No imposed values that would interfere with established levels of treatment. **Color:** True color less than 50 color units. **Taste and Odor:** Shall not unreasonably impair esthetic considerations. **Solids:** No dissolved solids above natural conditions causing corrosion or scaling problems. No visible evidence of other floating solids or sludge deposits. No imposed sediment loads that would interfere with established treatment levels.* **Toxic Substances:** Chemical constituents should be below concentrations found to be of public health significance.*
Arizona	6.5–8.6	0.5	93°	5°	—	**Radioactivity:** Not to exceed 1/30 of the MPC_w value given for continuous occupational exposure in NBS Handbook 69. **Turbidity:** 50 JCU (streams); 25 JCU (lakes). **Color:** Free from waste materials in amounts sufficient to change existing color enough to interfere with industrial use or to create a nuisance. **Taste and Odor:** Free from wastes in amounts sufficient to produce enough taste and odor to create a nuisance or interfere with industrial use. **Solids:** Free from wastes that would be unsightly, putrescent, odorous or in amounts that would interfere with industrial use. **Toxic Substances:** Free from wastes toxic to human, animal, plant or aquatic life or in amounts that would interfere with industrial use.
Arkansas	6.0–9.0	1.0 (24 hrs.)	95°	5°	4.0 (average for any cross section)	**Radioactivity:** "Rules and Regulations for the Control of Ionizing Radiation," Arkansas Board of Health, apply. **Turbidity:** No distinctly visible increases due to wastes. **Color:** Shall not be increased to the extent that it interferes with industrial use, present or future. **Taste and Odor:** Must not cause offensive odors or otherwise interfere with industrial use. **Solids:** No distinctly visible persistent solids, bottom deposits or sludge banks due to wastes. **Toxic Substances:** Must not be present in amounts toxic to human, animal, plant or aquatic life.
California	6.5–8.6 7.0–8.6 (Coastal waters)	—	71.6°* (fresh water)	None that would cause ecological change or harm aquatic life (coastal waters)*	6.0 Coastal water: 5.0 (unless naturally lower)	**Radioactivity:** Shall not exceed 1/10 of the MPC_w values given for continuous occupational exposure in NBS Handbook 69. **Turbidity:** Free from wastes that could alter water's existing turbidity. **Color:** Free from substances attributable to wastes that produce detrimental color. **Taste and Odor:** No substances that impart foreign taste or odor. **Solids:** Dissolved solids in fresh water must not exceed 300 mg./l. at any time; annual mean: 175 mg./l. Settleable solids must not be able to change nature of stream bottom or harm aquatic environment. **Toxic Substances:** At all times free from concentrations harmful to humans, aquatic life or wild or domestic animals.
Colorado	5.0–9.0	—	93°	—	3.0	**Radioactivity:** Not to exceed 1/30 of the 168-h.r.-week values in NBS Handbook 69. **Turbidity:** Must not interfere with established levels of treatment. **Color:** Wastes present must not cause appreciable change in color or interfere with industrial use. **Taste and Odor:** Free from wastes that cause odor or appreciable change in taste. **Solids:** Free from wastes that are unsightly, putrescent or odorous or would interfere with use. **Toxic Substances:** Free from wastes in concentrations or combinations sufficient to harm human or animal life.
Connecticut	6.0–9.0	—	—	None unless it does not exceed recommended limits for industrial use	2.0	**Radioactivity:** Limits to be approved by appropriate state agency. **Turbidity, Color, Taste and Odor:** None in such quantities that would impair industrial use. **Solids:** Limited to small amounts that may result from discharge of appropriately treated wastes. **Toxic Substances:** Free from chemical constituents in concentrations or combinations harmful to human, animal or aquatic life.
Delaware	6.5–8.5	—	—	5°	50%* or 4.0	**Radioactivity:** Alpha emitters limited to 3 pc/l.; beta emitters, to 1,000 pc/l. **Color, Taste and Odor:** None in concentrations that cause color, taste or odor. **Solids:** Free from unsightly and malodorous nuisances due to floating solids or sludge deposits. **Toxic Substances:** None in concentrations harmful (synergistically or otherwise) to humans, fish, shellfish, wildlife or aquatic life.
Florida	6.0–8.5	1.0	—	—	4.0	**Radioactivity:** Gross beta—1,000 pc/l. (in absence of Sr-90 and alpha emitters). **Turbidity:** 50 JCU. **Color:** Must not render water unfit for industrial-cooling or process-water supply purposes. **Taste:** Must not render water unfit for industrial use; phenols 0.001 maximum. **Solids:** Dissolved solids must not exceed 1,000 mg./l.; monthly average: 500 mg./l. Must be free from floating wastes that are unsightly or deleterious or other wastes that settle to form putrescent or objectionable sludge deposits. **Toxic Substances:** Free from wastes harmful to human, animal or aquatic life. Cu, 0.5 mg./l.; Zn, 1.0; Cr, 0.05; Pb, 0.05; Fe, 0.3; As, 0.05; F, 10.0; Cn, none detectable.

	pH Allowable Range	Deviation	Temperature (°F) allowable Maximum	Increase above ambient	Dissolved oxygen (minimum mg./L. or %)	Other Requirements
Georgia	6.0–8.5	—	90.2°	1.0° (above intake)	2.5 3.0 (daily average)	Radioactivity: Must conform to state statutes. Turbidity, Color, Taste and Odor: Free from wastes that cause objectionable conditions or interfere with industrial use. Solids: Free from wastes that are unsightly, putrescent or otherwise objectionable or would interfere with industrial use. Toxic Substances: No wastes in concentrations that would prevent fish survival or interfere with industrial use.
Hawaii	6.5–8.5	—	—	—	4.6	Radioactivity: Not to exceed 1/30 of the values given by NBS Handbook 69. Turbidity: Free from soil particles from erosion caused by land development or agricultural use. Taste and Odor: Wastes, after dilution and mixture, must not interfere with industrial use. Toxic Substances: Free from substances in concentrations harmful to human, animal, or marine life or that make waters unsuitable for industrial use.
Idaho	6.5–9.0	0.5	—	2° Only if water 68° or less	75% (at seasonal low)	Radioactivity: Not to exceed limits of '62 PHS Drinking Water Standards. Turbidity: No objectionable turbidity that can be traced to a point source. Solids: No floating or submerged matter; no sludge deposits that could adversely affect industrial use. Toxic Substances: No wastes of other than natural origin in concentrations of public health significance or that could adversely affect industrial use.
Illinois	5.0–9.0	—	95°	—	2.0 3.0 (for 16 hrs. in any 24-hr. period)	Color, Taste and Odor: Free from wastes that produce color, odor or taste in such a degree as to create a nuisance. Solids: Free from floating wastes that settle and form unsightly, deleterious or putrescent deposits. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Indiana	5.0–9.0	—	95°	—	1.0 2.0 (daily average)	Color, Taste and Odor: Free from wastes that produce color, taste or odor in such a degree as to create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; monthly average, 750 mg./l. Must be free from unsightly, putrescent, deleterious or otherwise objectionable wastes. Toxic Substances: Free from wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Iowa	—	—	—	—	—	Color, Taste and Odor: Free from wastes that produce color, taste or odor in such a degree as to be detrimental to industrial use. Solids: Free from floating wastes in amounts that would be unsightly or deleterious or other wastes that settle to form putrescent or objectionable sludge deposits. Toxic Substances: No wastes in concentrations or combinations detrimental to human, animal or aquatic life or to industrial use.
Kansas	6.5–9.0	—	90°*	—	4.0*	Turbidity: No increase that causes substantial visible contrast with natural appearance or that is detrimental to industrial use. Odor: Discharges of odor-producing substances limited to concentrations not detrimental to industrial use. Taste and Odor: Concentrations limited to those that would not result in noticeable offensive odors or otherwise interfere with industrial use. Solids: Free from floating debris or material in amounts that would be unsightly or detrimental to industrial use. Toxic Substances: Pollutional substances must be maintained below concentrations detrimental for industrial use.
Kentucky	5.0–9.0	—	96° 73° (Dec.-Feb.)	5°/hr 10°/day	—	Color, Taste and Odor: Wastes must not create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; monthly average, 750 mg./l. No floating wastes in unsightly or deleterious amounts; no other wastes that settle to form putrescent or objectionable sludges. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal, plant or aquatic life.
Louisiana	6.0–9.0	—	95.0°	5.0°	60%	Radioactivity: Specific limits set for all radioactive isotopes released as waste. Solids: None that would produce floating materials, sludge banks or beds on bottom, either organic or inorganic. Toxic Substances: No wastes in concentrations or combinations harmful to animal or plant life.
Maine	6.0–8.0*	0.5*	90°*	—	7.0*	Radioactivity: Not to exceed '62 PHS Drinking Water Standards. Turbidity, Color, Taste and Odor: Free from wastes that impart turbidity, color, taste or odor or impair industrial use. Solids: Free from sludge deposits, solid refuse and floating solids. Toxic Substances: No chemical constituents from waste sources harmful to humans or that adversely affect industrial use.
Maryland	5.0–9.0 (unless natural)	—	100°	—	4.0 (unless naturally lower)	Color, Taste and Odor: Free from waste materials that change existing color or produce taste and odor to such a degree as to create a nuisance or interfere with industrial use. Solids: Free from wastes that float, settle to form deposits, create a nuisance or interfere with industrial use and are unsightly, putrescent or odorous. Toxic Substances: Free from toxic wastes that interfere with industrial use or that are harmful to human, plant, animal or aquatic life.
Massachusetts	6.0–9.0	—	90°	—	5.0	Radioactivity: None in concentrations harmful to human, animal or aquatic life. Turbidity, Color, Taste and Odor: None in concentrations that would impair industrial use. Solids: None allowed except that which may result from the discharge from waste-treatment facilities providing appropriate treatment. Toxic Substances: None in concentrations or combinations harmful to human, animal or aquatic life.

	pH Range	pH Allowable Deviation	Temperature (°F) Maximum	Temperature allowable increase above ambient	Dissolved oxygen (minimum) mg./l. or %	Other Requirements
Michigan	6.5–8.8	0.5	[illegible]	10°	Enough to prevent nuisance	Radioactivity: Standards to be established when information is available on deleterious effects. Turbidity, Color: No objectionable unnatural turbidity or color in quantities sufficient to interfere with industrial use. Taste and Odor: Below levels that are or may become injurious to industrial use. Solids: Dissolved solids must not exceed 750 mg./l.; monthly average: 500 mg./l. No floating solids or objectionable deposits in quantities that would interfere with industrial use. Toxic Substances: Limited to concentrations less than those that are or may become injurious to this use.
Minnesota	6.0–9.0	—	90°	—	—	Color, Taste and Odor, Solids: Free from wastes that cause nuisance conditions, such as material discoloration, obnoxious odors, significant floating solids, excessive suspended solids or sludge deposits.
Mississippi	6.0–8.5	1.0	93°	10°	3.0	Color, Taste and Odor: Free from wastes that produce color or odor in such degree as to create a nuisance. Solids: Dissolved solids must not exceed 1,500 mg./l.; monthly average 750 mg./l. Must be free from floating wastes that settle to form unsightly, deleterious, objectionable or putrescent deposits. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal or aquatic life.
Missouri	6.5–9.0	—	90°	9° (average of cross section)	4.0	Radioactivity: Gross beta: 1,000 pc/l. (In absence of Sr-90 and alpha emitters). Sr-90: 10 pc/l. Dissolved Ra-226: 3 pc/l. Color: Wastes must not cause substantial visible contrast with natural appearance of stream or interfere with industrial use. Taste and Odor: Limited to concentrations that would not result in noticeable offensive odors or otherwise interfere with industrial use. Solids: No noticeable organic or inorganic deposits or floating materials in unsightly or deleterious amounts. Toxic Substances: Concentrations not detrimental to industrial use or toxic to humans, fish, wildlife, P.L.2.
Montana	6.5–8.5	0.5	—	No adverse change	—	Radioactivity: Not to exceed '62 PHS Drinking Water Standards. Turbidity: Must not interfere with established levels of treatment. Color, Taste and Odor: Water shall be maintained in condition not offensive to sense of sight or smell. Solids: No floating solids and sludge deposits in amounts deleterious to industrial use; no sediments or settleable solids that affect treatment levels. Toxic Substances: Amounts present must not adversely affect industrial use.
Nebraska	6.5–9.0	1.0	90°	5° (May–Oct.) 10° (Nov.–Apr.) Rate: 2°/hr.	5.0	Radioactivity: Must conform with Radiological Health Regulations (1st. ed.), State of Nebraska, '66. Turbidity: No more than 10% increase above normal level. Color: No evidence of matter that creates nuisance conditions. Taste and Odor: Less than amounts that would degrade water quality for industrial use: phenol: 0.001 mg./l. Solids: Dissolved solids must not exceed 1,000 mg./l. No more than 20% increase (limit 100 mg./l.) from any point source. No waste solids that permit deposition or are deleterious to industrial use. Toxic Substances: None in concentrations or combinations that would render water unsuitable for industrial use.
Nevada	6.5–8.5 Annual median: 7.4–8.3	—	77.0° (summer) 57.2° (winter)	—	5.0 6.0 (average, June–Sept.)	Radioactivity: Limited to 1/10 of the 168-hr.-week values in NBS Handbook 69. Turbidity, Color, Taste and Odor: Free from wastes in amounts sufficient to change existing turbidity or color enough to create a nuisance or interfere with industrial use, or to produce taste or odor in the water. Solids: Free from floating or other wastes that settle to form sludge banks or deposits in amounts that would be unsightly or odorous or interfere with industrial use. Toxic Substances: Free from wastes in concentrations or combinations toxic to human, animal, plant or aquatic life or that interfere with industrial use.
New Hampshire	6.0–8.5 (unless natural)	[illegible]	[illegible]	No increase that would interfere with this use	5.0	Turbidity, Color, Taste and Odor: None in objectionable amounts. Solids: No floating solids or sludge deposits in objectionable amounts. Toxic Substances: None in toxic concentrations or combinations.
New Jersey	6.5–8.5 (unless natural)	—	85° (unless natural)	5° (up to 85°)	4.0	Turbidity, Solids: None noticeable in water or deposited along shore. Color, Taste and Odor: None that are offensive to humans or detrimental to aquatic biota. Toxic Substances: None that would affect humans or be detrimental to aquatic biota.
New Mexico	6.6–8.6	—	—	Must not pollute or make water unfit for this use	No oxygen demand that would cause pollution	Radioactivity: Not greater than 1/10 of the 48-hr. value in NBS Handbook 69. Turbidity: Shall not cause substantial visible contrast with natural appearance. Color: Should not create an aesthetically undesirable condition. Taste and Odor: No odors, other than of natural origin, that are esthetically objectionable or [illegible]. Solids: No objectionable floating solids or debris and sediment that significantly alter properties of bottom. Toxic Substances: No amounts toxic to humans, plants, fish, animals.
New York	6.0–9.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] No industrial wastes that alone or in combinations make water unsuitable for industrial use. Solids: No floating or settleable solids or sludge deposits that are readily visible and attributable to wastes. Toxic Substances: None alone or in combinations that would impair industrial use. [illegible]

Water quality standards

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above ambient	Dissolved oxygen (minimum) mg./l. or %	Other Requirements
[illegible] Carolina	Normal for area	—	[illegible]°	7°	3.0	Color: Must not render water unfit for industrial cooling. Solids: Must not, after dilution and mixture, make water unfit for industrial cooling. Toxic Substances: Must not make water unfit for industrial cooling.
[illegible] Dakota	6.0-8.0	[illegible]	[illegible]°	10°	3.0 5.0 (for 16 hrs./day)	Radioactivity: No discharge allowed unless materials are readily soluble or dispersible and of quantities acceptable to state health department. Color, Taste and Odor: No wastes that color water or result in objectionable odors to a degree that impairs industrial use. Solids: No unsightly floating wastes that would adversely affect industrial use or wastes that settle to form putrescent or objectionable deposits. Toxic Substances: No concentrations or combinations harmful to human, animal or aquatic life.
Ohio	6.0-8.0	—	90°	—	1.0 2.0 (daily average)	Color, Taste and Odor: Free from wastes that produce color or odor to a degree that creates a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; monthly average: 750 mg./l. Must be free from floating or other wastes that settle to form putrescent or objectionable deposits or that are unsightly or deleterious. Toxic Substances: No wastes in concentrations or combinations harmful to human, animal or aquatic life.
Oklahoma	6.5-8.5	—	93°	5°	4.0	Radioactivity: Average concentration at points of controlled release shall not exceed State Board of Health Radiation Protection Regulations. Turbidity: None that causes visible contrast with natural conditions. Color: None that is persistent in concentrations detrimental to industrial use. Taste and Odor: No concentrations that would cause offensive odors in vicinity of water or otherwise interfere with industrial use. Solids: Free from floating debris, bottom deposits or other materials. Toxic Substances: None in quantities that make water toxic to human, animal, plant or aquatic life.
Oregon	6.5-8.5	—	—	2° (only if water 70° or less)	5.0	Radiation: Shall not pose external hazard. Turbidity: 5 JCU above natural. Color, Taste and Odor: No objectionable discoloration or conditions esthetically offensive to human senses of taste or smell. Solids: No floating solids, organic or inorganic deposits injurious to industry. Toxic Substances: No conditions injurious to public health.
[illegible]sylvania	6.0-9.0	—	93°	2°/hr.	4.0 5.0 (daily average)	Color, Taste and Odor: No wastes that produce colors, tastes or odors in amounts harmful to industrial use. Solids: Dissolved solids must not exceed 750 mg./l.; monthly average: 500 mg./l. No floating wastes or substances that settle to form sludge in amounts harmful to industrial use. Toxic Substances: None in amounts harmful to industrial use.
[illegible] Island	6.0-8.5	—	—	4°	3.0° 5.0° (16 hrs./day)	Radioactivity, Toxic Substances: No concentrations or combinations harmful to human, animal or aquatic life. Turbidity, Taste and Odor: None in concentrations that would impair industrial use. Solids: No solid refuse, floating solids or sludge deposits.
[illegible] Carolina	6.0-8.5 6.0-8.5 (seacoast)	—	93.2°°	10°°	2.0°° 2.5° (seacoast)	Turbidity, Color, Taste and Odor: Free from wastes that change the existing turbidity or color or that produce taste or odor to such a degree as to cause a nuisance or interfere with industrial use. Solids: None from waste sources in amounts that are unsightly, putrescent, odorous or that cause a nuisance or interfere with industrial use. Toxic Substances: Free from wastes harmful to human, animal, plant or aquatic life or that interfere directly or indirectly with industrial use.
[illegible] Dakota	6.0-8.5	1.0	—	—	—	Radioactivity: None permitted in water unless readily soluble or dispersible and in quantities allowed by federal or state agencies. Color, Taste and Odor: No wastes that produce material discolorations or undesirable odors. Solids: Dissolved solids must not exceed 2,000 mg./l. No wastes producing floating solids, sludge deposits or other offensive effects. Toxic Substances: None in concentrations toxic to human, animal or aquatic life.
[illegible]	[illegible]	[illegible]	[illegible]°	10° (seacoast) 5°/hr.	Enough to prevent offensive conditions	Radioactivity: None that could adversely affect industrial use. Turbidity, Color: None in amounts or concentrations that could not be reduced to acceptable levels by conventional treatment. Taste and Odor: None that would result in taste or odor that would prevent use for industrial processing. Solids: Dissolved solids must not exceed 500 mg./l. No distinctly visible solids, bottom deposits or sludge banks that could be detrimental to industrial use. Toxic Substances: None that produce toxic conditions that would adversely affect water for industrial use.
Texas	[illegible]	—	—	—	4.0	Radioactivity: Regulated by Texas Radiation Control Act and Texas Regulations for Control of Radiation. Turbidity: No substantial increase due to wastes. Color: No substantial visible contrast with natural appearance of receiving waters after wastes receive best practical treatment. Taste and Odor: No concentrations that produce offensive odors. Solids: Dissolved solids must not exceed 1,000 mg./l., unless water used only for cooling, must be reasonably free from floating or settleable suspended solids that would adversely affect industrial use. Toxic Substances: Shall not show acute or chronic toxicity to humans, animals or aquatic life to such an extent as to interfere with industrial use.

Water quality standards

	pH Allowable Range	pH Allowable Deviation	Temperature (°F) allowable Maximum	Temperature (°F) allowable Increase above ambient	Dissolved oxygen (minimum mg./L. or %)	Other Requirements
Utah	6.5–9.0	—	—	—	—	Radioactivity: Shall not exceed 1/30 of MPC$_e$ values for continuous occupational exposure in NBS Handbook 69. Turbidity, Color: No wastes in amounts that would change existing turbidity or color enough to create public nuisance or interfere with industrial use. Taste and Odor: No wastes in amounts that would produce taste or odor. Solids: No floating wastes that are unsightly or that interfere with industrial use; no wastes that settle to form unsightly or odorous sludge or bottom deposits. Toxic Substances: No wastes in concentrations or combinations toxic to human, animal, plant or aquatic life or that would interfere with industrial use.
Vermont	6.0–8.5	—	—	4°	3.0° 6.0° (16 hrs./day)	Radioactivity: To be approved by appropriate state agency. Turbidity, Color, Taste and Odor: None in concentrations that would impair industrial use. Solids: No floating solids, sludge deposits or solid refuse. Toxic Substances: No chemical constituents in concentrations or combinations harmful to human, animal or aquatic life.
Virginia	5.0–9.0 (swamps as low as 4.3)	—	95°* (unless naturally higher)	No sudden changes that could harm aquatic life	1.0° 2.0° (daily average)	Color, Taste and Odor: No wastes that change existing color or produce odor to such a degree as to create a nuisance or interfere with industrial use. Solids: No floating wastes that are unsightly or create a nuisance or other wastes that settle to form unsightly, putrescent or odorous deposits. Toxic Substances: No wastes in concentrations or combinations that would interfere directly or indirectly with industrial use.
Washington	6.5–8.5	0.5	70°	t = 110/(T-15)††	6.5 or 70%	Radioactivity, Toxic Substances: Below concentrations that could adversely affect industrial use. Turbidity: Less than 10 JCU over natural conditions. Color, Taste and Odor, Solids: Dissolved, suspended, floating or submerged matter shall not reduce esthetic values so as to affect industrial use.
West Virginia	Process water: 5.5–9.0 Cooling water: 5.0–9.0	—	Cooling water: 93° (May-Nov.) 73° (Dec.-Apr.) Process water must permit fish passage	5° Rate: 2°/hr. (Dec.-Apr.)	1.0 2.0 (daily average)	Color: None that is objectionable. Taste and Odor: No objectionable odors in vicinity of the water. Solids: No distinctly visible floating, settleable or suspended solids of unreasonable kind or quantity. No objectionable bottom deposits or sludge banks. Toxic Substances: No concentrations of materials poisonous to human, animal or fish life.
Wisconsin	6.0–8.0	0.5	89°	—	1.0 2.0 (daily average)	Color, Taste and Odor: No materials producing color, taste or odor in amounts that would create a nuisance. Solids: Dissolved solids must not exceed 1,000 mg./l.; daily average: 750 mg./l. No floating or submerged debris or waste substances that would cause objectionable deposits in amounts to create a nuisance. Toxic Substances: None in concentrations or combinations toxic to humans or of public health significance.
Wyoming	6.5–8.5	—	—	4° 2° (for streams where temp. not over 70°)	6.0	Radioactivity: Not to exceed 1/30 of NBS Handbook 69 values. Turbidity: No more than 15 JCU above natural (when turbidity is 150 JCU or less); otherwise, no more than 10% above natural. Color: Essentially free of wastes that visibly alter natural color of water or impart color to vessels or structures. Taste and Odor: Essentially free from substances that would produce detectable odor at site of use. Solids: Essentially free from floating or settleable solids that are unsightly or settle to form sludge, bank or bottom deposits. Toxic Substances: Free from toxic substances in concentrations or combinations toxic to human, animal or aquatic life.

* Standard reserved from Federal Water Pollution Control Administration approval.
†† = total cumulative heat addition allowed from unnatural waste sources, at any point throughout the given stream reach. T = highest occurring temperature for a given period, in a specific stream reach.
Abbreviations: PHS—Public Health Service; NBS—National Bureau of Standards; JCU—Jackson Candle Units; pc/l.—picocuries per liter.
Source: Water Quality Standards of the United States, Territories, and the District of Columbia, American Public Health Assn., Subcommittee on Water Quality Control, and Engineering and Sanitation Section.
Notes: Specific limits for coliforms, biologic oxygen demand, plant nutrients, oil, grease, scum, bottom deposits, pesticides, specific conductance, carbon chloroform extract, synthetic detergents not included. Some states set standards for each stream reach or river basin; in such cases, table shows least stringent requirement.

This reprint is an excerpt from the "Plant Sites, '69" report
that appeared in the October 29, 1969 issue of CHEMICAL WEEK

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

January 31, 1972

Dear Sir:

We are writing to tell you that effective June 30, 1972, all Pydraul fluids will be a new formulation. We have decided to stop using polychlorinated terphenyls as a component in our fluids. Our new fluids will contain no chlorinated components.

In order to make a smooth transition to the new Pydraul fluids, we will continue to manufacture fluids with the current formulation until early in the second quarter of 1972. At that time we will begin phasing in the new formulations and phasing out the old. We expect to complete this transition well before June 30, 1972.

In the meantime we will make every effort to contact each of you, our customers, individually. We would like to work out with you the details of this transition so that it best satisfies your needs.

Yours very truly,

Howard S. Bergen

Howard Bergen, Director
Specialty Products Group
Monsanto Industrial Chemicals Company

lb

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

March 15, 1972

Dear Sir:

Confirming our previous letters on the Pydraul reformulations we will begin shipping the new Pydraul products, as present fluid inventories are depleted, within the next 30 - 60 days. How soon you begin receiving the new formulations will depend on the inventory in the warehouse in your area.

Attached is a list of the new Pydraul products along with the present Pydraul line being replaced. The new Pydraul products are compatible with present fluids and with seals and packings in your Pydraul systems. Pricing on the new products is competitive with the present Pydraul line.

We thank you for your cooperation during this changeover program. As in the past, it remains our desire to serve you with the best in fire resistant hydraulic fluids. Should you have additional questions regarding the new Pydraul line, please contact the Pydraul Fluids Specialist in your area.

Yours very truly,

Howard S. Bergen

Howard S. Bergen, Director
Specialty Products Group
Monsanto Industrial Chemicals Compa

lb

CONVERSION

	OLD PRODUCT	NEW PRODUCT
SELECTOR 1	PYDRAUL 60	PYDRAUL 10 E (SAME)
	PYDRAUL 150 A	PYDRAUL 29 E LT
	PYDRAUL AC A Winter Grade	PYDRAUL 30 E
	PYDRAUL A-200-B	PYDRAUL 50 E
	PYDRAUL F-9-A	PYDRAUL 50 E
	PYDRAUL AC A	PYDRAUL 90 E
	PYDRAUL 625 A	PYDRAUL 115 E
SELECTOR 2		
	PYDRAUL 135 A	PYDRAUL 230 C
	PYDRAUL 230 A	PYDRAUL 230 C
	PYDRAUL 312 A	PYDRAUL 312 C
	PYDRAUL 540 B	PYDRAUL 540 C

CONVERSION

	OLD PRODUCT	NEW PRODUCT
SELECTOR 1	PYDRAUL 60	PYDRAUL 10 E (SAME)
	PYDRAUL 150 A	PYDRAUL 29 E LT
	PYDRAUL AC A Winter Grade	PYDRAUL 30 E
	PYDRAUL A-200-B	PYDRAUL 50 E
	PYDRAUL F-9-A	PYDRAUL 50 E
	PYDRAUL AC A	PYDRAUL 90 E
	PYDRAUL 625 A	PYDRAUL 115 E
SELECTOR 2		
	PYDRAUL 135 A	PYDRAUL 230 C
	PYDRAUL 230 A	PYDRAUL 230 C
	PYDRAUL 312 A	PYDRAUL 312 C
	PYDRAUL 540 B	PYDRAUL 540 C

ROCW 00109

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

August 3, 1973

Dear Sir:

In February, 1971 we announced the reformulation of our Pydraul[R] industrial fluids to eliminate the use of polychlorinated biphenyls (PCBs) as components of these fluids. Since then we have reviewed our formulations and taken further steps to remove all chlorinated compounds from our Pydraul[R] fluids. Pydraul[R] fluids containing chlorinated materials have not been sold since mid-1972.

Recently the Food and Drug Administration published in the Federal Register (Vol. 38, No. 129, pgs. 18096-18104, July 6, 1973) a final rule-making order regulating the sources by which polychlorinated biphenyls (PCBs) may contaminate animal feed, food, and food-packaging materials during manufacturing, handling and storage, and limiting the levels of PCBs that may be present in animal feed, food, and food packaging materials as a result of unavoidable, environmental contamination. Attached is a copy for your use.

Because you may have purchased Pydraul[R] fluid prior to our changeover activities in mid-1972 which may have contained PCBs, you may wish to review your procedures and inspect your facilities at this time to insure that your operations are in compliance with the new regulation. To assist you in any investigations you may care to conduct, I have attached a list identifying the Pydraul[R] fluids which contained chlorinated ingredients and those which do not.

Proper disposal of chlorinated materials requires high temperature incineration. Monsanto has installed a facility at its Sauget, Illinois plant and has made this service available to its customers. Information relating to this service is attached to help you should you decide to dispose of such materials in this manner.

ROCW 00070

Our current line of Pydraul^{R} fluids which do not contain chlorinated materials do not require this method of disposal.

I hope this information is useful to you. If I can be of further service please let me know.

Sincerely,

Cumming Paton
Product Manager
Fluids

/pep
Enclosures

PYDRAUL[R] FLUIDS WHICH CONTAINED CHLORINATED INGREDIENTS

Pydraul[R] 90	Pydraul[R] 540B
Pydraul[R] 135	Pydraul[R] 625
Pydraul[R] 135A	Pydraul[R] 625A
Pydraul[R] 150	Pydraul[R] AC
Pydraul[R] 150A	Pydraul[R] AC-A
Pydraul[R] 230	Pydraul[R] AC-A Winter Grade
Pydraul[R] 230A	Pydraul[R] AC Winter Grade
Pydraul[R] 280	Pydraul[R] A-200
Pydraul[R] 312	Pydraul[R] A-200A
Pydraul[R] 312A	Pydraul[R] A-200B
Pydraul[R] 540	Pydraul[R] F-9
Pydraul[R] 540A	Pydraul[R] F-9A

CURRENT PYDRAUL[R] FLUIDS (DO NOT CONTAIN CHLORINATED INGREDIENTS)

Pydraul[R] 10E (formerly Pydraul[R] 60)	
Pydraul[R] 29E LT	
Pydraul[R] 30E	
Pydraul[R] 50E	Pydraul[R] 230C
Pydraul[R] 65E	Pydraul[R] 312C
Pydraul[R] 90E	Pydraul[R] 540C
Pydraul[R] 115E	Pydraul[R] MC (formerly MCS 1330)

ROCw 00072

Monsanto

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

INCINERATION SERVICE FOR PYDRAUL^{R} FLUIDS

This will confirm our conversation concerning incineration of your fluids. Enclosed are pre-addressed drum return labels marked "Disposal Only". The drum contents must be clearly indicated on each label.

To prevent leakage, please use return drums which meet DOT 17E specifications (55 gallon drums, 18 gauge, 2 bung head; 5 gallon drums, 24 gauge minimum). The outside of the drums must be clean, free of fluid and not leaking. Cleanup or other costs affecting the carrier which are related to fluids leaking from drums will be charged to the shipper.

Please show Monsanto Identification Number on the bill of lading and on each drum. The freight classification is Hydraulic System Fluid other than Petroleum and the release value is 50¢ per pound. Please ship all drums freight prepaid to:

Monsanto Industrial Chemicals Co.
Department 246, Incinerator
Sauget, Illinois 62201

Incineration charges for Pydraul^{R} fluids are 5¢ per pound. Please advise if you want us to invoice these charges against a specific purchase order number.

ROCw 00073

Solids such as sawdust, rags or sludge and aqueous fluids cannot be handled in our incinerator. For these materials we suggest you check local authorities and your own environmental department for an approved disposal method. Personnel in our Sauget, Illinois, plant have been instructed to refuse receipt of drums containing these materials and to return them to the sender at the sender's expense.

Thank you for your cooperation. If you have additional questions, please phone me (314) 694-3354, or contact me by letter at the above address.

Sincerely,

W. N. MADDOX
Supervisor
Customer Service Center

Enclosures

federal register

FRIDAY, JULY 6, 1973
WASHINGTON, D.C.

Volume 38 ■ Number 129

PART II

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Food and Drug Administration

■

POLYCHLORINATED BIPHENYLS

Contamination of Animal Feeds, Foods, and Food Packaging Materials and Availability of Supplement to Environmental Statement on Rulemaking

Title 21—Food and Drugs

CHAPTER I—FOOD AND DRUG ADMINISTRATION, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

SUBCHAPTER A—GENERAL

SUBCHAPTER B—FOOD AND FOOD PRODUCTS

POLYCHLORINATED BIPHENYLS (PCB's)

Contamination of Animal Feeds, Foods, and Food-Packaging Materials

In the FEDERAL REGISTER of March 18, 1972 (37 FR 5705) a notice of proposed rule making was published limiting the sources by which polychlorinated biphenyls (PCB's) may contaminate animal feed, food, and food-packaging materials during manufacturing, handling, and storage, and limiting the levels of PCB's that may be present in animal feed, food, and food-packaging materials as a result of unavoidable, environmental contamination. The notice provided for the filing of comments within 60 days after the date of publication and this was extended to July 16, 1972 by a notice published May 18, 1972 (37 FR 10003).

In response to the notice, ninety-three comments were received from members of industry, trade associations, consumer groups and individual consumers.

The following is a summary of the provisions contained in the notice and the comments on these provisions received by the Food and Drug Administration:

1. *Sections 3.93, 128.4, and 135.113.* The notice included provisions which would prohibit the use of PCB-containing materials and equipment in animal feed, in food, and in food-packaging material manufacturing, handling and storage establishments, in order to preclude direct, accidental PCB contamination of animal feed, food, and food-packaging materials.

a. One comment suggests that since most industrial chemicals can be interpreted to be "harmful or deleterious", the phrase should be deleted as a criterion for PCB replacement. The Commissioner concurs with deleting the phrase "harmful or deleterious". The toxicity and other characteristics of fluids selected as PCB replacements must be adequately determined so that the least potentially hazardous replacement is used. In making this determination with respect to a given fluid, consideration should be given to (1) its toxicity; (2) the maximum quantity that could be spilled onto a given quantity of food before it would be noticed, taking into account its color and odor; (3) possible signaling devices in the equipment to indicate a loss of fluid, etc.; and (4) its environmental stability and tendency to survive and be concentrated through the food chain. The judgment as to whether a replacement fluid is sufficiently nonhazardous is to be made on an individual installation and operation basis. Accordingly, the appropriate amendments have been made in § 135.113(b)(3) (21 CFR 135.113(b)(3)), § 3.93(b)(2) (21 CFR 3.93(b)(2)), and § 128.4(b)(3) (21 CFR 128.4(b)(2)).

b. One comment argues that electrical capacitors and transformers should be exempt from the requirement that new equipment and existing equipment in establishments engaged in the processing of animal feed, human food, or packaging materials shall not contain PCB's, since no known substitute is available which offers the proper balance of characteristics (e.g., fire safety and design efficiency). In support of the comment, it is stated that both capacitors and transformers are constructed in sealed metal cases and are not normally installed in equipment or located in such a manner as to be in direct contact with the material being processed. The Commissioner of Food and Drugs agrees that there should be an exemption for the safe use of PCB's in electrical capacitors and transformers. The final order has been amended in § 135.113(c), § 3.93(c) and § 128.4(b)(3), to provide an exemption for electrical capacitors and transformers.

c. One comment contends that an effective date of 90 days following publication of the final order should be established since this time period would be required for the modification of existing plant equipment to accommodate PCB replacements. The Commissioner concludes that there is no justification for extending the effective date and the final order establishes an effective date of 30 days from the date of publication in the FEDERAL REGISTER.

d. One comment contends that with the replacement of PCB formulated heat exchange fluids with non-PCB fluids, some level of PCB residue is likely to remain in certain equipment. Therefore, the comment continues, the Food and Drug Administration should initiate studies for the purpose of establishing a finite allowable residual level. While it is true that some residue of PCB may remain in certain equipment, if the change is made in a reasonable manner and in good faith there should not be significant concentrations of PCB remaining. Without additional data it is not possible to set any specific limit for PCB concentration in the equipment fluids. Furthermore, the Commissioner has determined that no reasons exists for FDA to initiate studies to determine the extent of residual levels of PCB's in heat exchangers or to specify by regulations finite tolerances for such residual material at this time.

2. *Section 121.2546.* The notice included an amendment to the existing food additive regulations (21 CFR 121.2546) so as to exclude from use in food-packaging materials pulp from reclaimed fibers containing poisonous and deleterious substances which may migrate to the packaged food.

a. One comment contends that the language of the amendment is incomplete since it does not establish a limit or tolerance for poisonous or deleterious substances, such as PCB's, which may ultimately be found in the packaged food product. The Commissioner disagrees because the purpose of § 121.2546 is to regulate the use of reclaimed fibers containing poisonous or deleterious substances for use in the manufacture of food-packaging materials and, to the extent necessary, to prevent contamination of the packaged food product with these substances. Therefore, the regulation precludes the necessity of establishing tolerances for the packaged food product. The Commissioner agrees, however, the clarification of the amendment is needed in order to be consistent with regulations which permit the presence of what could otherwise be regarded as poisonous or deleterious substances at levels that have been proved to be safe in food-packaging materials. Therefore, the order is amended in § 121.2546 by adding the phrase "except as provided in regulations promulgated under Sections 406 and 409 of the Federal Food, Drug, and Cosmetic Act."

3. *Part 122.* The notice included the proposal to establish temporary tolerances under Section 406 of the Federal Food, Drug, and Cosmetic Act for unavoidable PCB residues in animal feed, certain foods and food-packaging materials as a result of environmental contamination.

a. One comment recommends that a zero tolerance for PCB's in foods and feeds should be established. The Commissioner rejects this recommendation. Animal feeds, certain foods, and paper food-packaging materials contain PCB's which, under present conditions of environmental contamination, are unavoidable. Current toxicological information does not support the necessity of establishing zero tolerances for these articles in order to protect public health since human exposure to dietary sources of PCB's is usually sporadic, non-systematic, and occasional. The "finite" temporary tolerances being established will provide the assurance that significant PCB levels are not contained in food and that human exposure to PCB's from dietary sources will be maintained at safe and minimal levels. Zero tolerances, therefore, are unwarranted and would unnecessarily deprive the consumer of a portion of his food supply and disrupt the Nation's food distribution system because a portion of fish, poultry, eggs, and milk and packaging used for food would be violative.

b. A consumer group's comment recommended lowering the PCB tolerances for human foods by a factor 5–10; while another comment recommended that the temporary tolerances should be based on toxicological data which would allow a level that is deemed safe rather than allow a level that can be reasonably achieved. The Commissioner disagrees with both recommendations. Section 406 of the act, which is the authority for establishing the temporary tolerances for PCB's, states that where the addition of a poisonous or deleterious substance to food cannot be avoided the Secretary shall promulgate regulations "limiting the quantity therein or thereon to such extent as he finds necessary for the protection of the public health", and also specifically states that the Secretary in setting such a tolerance shall take into account the extent to which use of the substance "cannot be avoided". The fact

that the tolerances are termed "temporary" is recognition that, in the future, there should be less PCB contamination which "cannot be avoided" and the Commissioner is authorized to reduce the tolerance levels accordingly. The temporary tolerance levels are based on an analysis of animal and human toxicological data and data on the occurrence of PCB's in the food supply as follows:

(1) *Animal toxicological data.* Data from long-term animal studies are available to show that the no-effect level in rats and dogs (for PCB's with 42, 54, and 60 percent chlorination) is 10 parts per million (ppm). Employing a 100 to 1 safety factor, the "no-effect" level for man would be 2.5 microgram (mcg)/kilogram (kg) body weight/day based on data drived from dogs, or 3 mcg/kg body-weight/day from rats. Therefore, based on long-term animal studies, the allowable level of PCB ingestion in man would be approximately 175 mcg/day for a 70 kg individual.

(2) *Human toxicological data.* Human intoxication with Kanachlor 400, a PCB manufactured in Japan with 48 percent chlorine was noted when a heat exchanger leaked fluid into rice oil and was consumed by Japanese families in 1968. About 1,000 people were eventually affected. Typical clinical findings included chloracne and increased pigmentation, visual impairment due to hypersecretion of the Meibomian glands, and systemic gastrointestinal symptoms that included abdominal pain and disturbances in liver function. A few babies were born with decreased birth weights and skin discoloration which slowly regressed as the children grew in size, although the growth rate of males appeared to be somewhat slower than normal. Adult patients had protracted clinical disease with very slow regression of symptoms and signs, suggesting slow metabolism and excretion of this PCB in humans, probably involving a long biological half-life. Exposure levels to the oil were calculated to approximate, on the average, 15,000 mg per day. The oil itself was reportedly contaminated at a level of about 2,000 ppm. This level was derived from the known organic chlorine content of rice oil related to the known organic chlorine content of Kanachlor 400. The average total dose of PCB's causing an effect in the Japanese was reported to be 2,000 mg. The human data published by Karatsuma, et al., Fukuoka Acta. Med. 23:117 (1971) established that the lowest level of PCB that produced an effect in man (using a 50 kg man) was 500 mg consumed over a period of 50 days at a rate of approximately 200 mcg/kg body weight/day. The effect level was based on overt symptoms rather than sensitive biochemical tests that might have demonstrated some effects at even lower levels. Employing a safety factor of 10 to 1 to go from an effect level in man to a permissible no-effect level in man allows for an ingestion of 20 mcg/kg body weight/day; or 1.4 mg/day for a 70 kg man based on a total period of exposure of 50 days (equivalent to the Japanese incident). Since PCB's probably have a long biological half-life in man, an alternative toxicological analysis of the human data may be based on the assumption that ingested PCB's would continue to accumulate in tissues for a long period of time. Since 2,000 mg was reported to be the average total dose causing an effect in the Japanese, it is possible that 200 mg total dosage PCB's (applying a safety factor of 10 to 1 as above) may be tolerated over a much more protracted period of time without overt adverse effect if daily exposure is held to minimal levels. It would take 22 months of daily ingestion of 300 mcg of PCB's to arrive at a total ingestion of 200 mg. This would permit ingestion of 4 mcg/kg/day as derived from a 70 kg man. Since the lowest total dose producing an effect in man was 500 mg, a similar analysis leads to an allowable protracted ingestion of 1 mcg/kg/day as derived from a 70 kg man.

(3) *Dietary sources of PCB's.* The results of FDA total diet studies for fiscal years 1970–1972 show that quantitatively measurable residues of PCB's are equivalent to an intake of approximately 0.08 mcg/kg/body weight/day (or 4.2 mcg/day for a 70 kg man). Because of the sensitivity of the analytical methods used, PCB's may be present at levels too low to be detected. If lower levels could be measured, the dietary intake of PCB's from the total diet studies would probably show an increase. It should be recognized, however, that in rare instances some people could have more systematic exposures to PCB's in foods than those expected by eating a moderately well balanced diet such as represented by the total diet samples. Hence, there is a need for minimizing potential human exposures. The total diet studies indicate that PCB's most frequently occur in the food composite consisting of meat, fish and poultry (experience has shown that most of the PCB residues in this composite are in fish and, to a lesser extent, poultry) and in the food composite consisting of grain and cereal products (experience has shown most of the PCB residues in this composite are derived from paper packaging materials). FDA's food surveillance activities have shown that PCB's also occur in dairy products, eggs, and packaged foods, in addition to packaged cereal products.

(4) *Temporary tolerances for PCB's.* Using the human toxicological data described above, FDA concludes that for the short term, based on the lowest total dose producing an effect and estimated biological half-life of PCB's, current levels of PCB's in the diet represent no immediate hazard. This is also true for the average total dose causing an effect in the Japanese for long-term exposure. However, based on the most sensitive "Japanese patient" (i.e., lowest total dose producing an effect), the possibility of potential long-term hazards necessitates reduction of the levels of PCB's in food as soon as possible. In the interim, temporary tolerances are necessary to limit human exposure to those foods that may contain PCB's resulting from environmental contamination, which as a practical matter are presently unavoidable. Those foods, for which temporary tolerances are being established, include milk and dairy products, poultry, eggs, fish, and infant and junior food. Infants and young children consume a greater amount of food per kilogram of body weight and thereby have a proportionately greater exposure than do adults. A separate temporary tolerance for infant and junior food, therefore, reflects the possibility that undesirable exposures could result if combinations of certain PCB-contaminated foods comprise a major portion of this age group's diet. In order to minimize the overall dietary intake of PCB's, individual sources of PCB contamination must also be appropriately minimized. PCB's have been shown to occur in packaged food as a result of the PCB contamination of paper food-packaging materials. Limitations on the levels of PCB's in paper food-packaging materials are, therefore, necessary to minimize the amount of PCB's which may migrate to the packaged food. Since PCB's can be transmitted to and concentrated in edible portions of food-producing animals ingesting PCB-contaminated feed, animal feed represents another source of PCB's in the food supply. Limitations on the levels of PCB's in animal feeds and animal feed components are necessary, therefore, to minimize the frequency and magnitude of PCB residues in feeds of animal origin.

The Commissioner concludes that the temporary tolerances being established will protect the public health from PCB's in food, but cautions that the temporary tolerances are not to be construed as "guidelines" permitting the consumption of foods containing these amounts of PCB's on a regular and consistent basis. Further, the temporary tolerances will be lowered as experience indicates that lower levels can be attained.

c. One comment recommends that FDA issue warnings to pregnant women who breast feed their babies to restrict their intake of fish to species that have been thoroughly monitored by FDA and found to be uniformly within the temporary tolerance. The basis for this recommendation is that consumption of PCB-containing fish and, for that matter other foods, may result in transfer and storage of PCB residues in human milk which in turn, the comment contends, would present a hazard to breast fed babies. The Commissioner concludes that such a warning is not warranted. On the basis of available, but limited monitoring data, most of which is unpublished, it appears that PCB levels in human milk would generally be less than approximately 0.06 ppm (whole product basis). Analysis of available toxicological data involving multigeneration reproduction studies in rat indicates that this level presents no immediate hazard to infants. Furthermore, this level is substantially less than the level of PCB's FDA will permit in the milk of dairy cows. The temporary tolerance being established for milk is 2.5 ppm (fat basis), which is

equivalent to 0.1 ppm (whole product basis). Therefore, a public warning as recommended is not supported by the scientific facts available at this time.

d. One comment recommends clarification of the term "PCB's" so as to distinguish between PCB-compounds of different chemical composition. The basis for this comment is the fact that PCB's are mixtures of chlorinated biphenyl compounds. Each component of the PCB mixture is a specific chemical compound having the basic biphenyl moiety and one to ten chlorine atoms. There are 209 different chlorinated biphenyl compounds. Each component of manufactured and sold in the United States under the registered trade name of Aroclor, followed by a four digit number (i.e., 1242; 1248; 1254; etc.). The term Aroclor signifies that the product consists of chlorinated biphenyls, chlorinated terphenyls, or a mixture of these compounds. The first two digits of the numerical part of the trade name indicate the molecular type (1200 signifies chlorinated biphenyl), while the last two digits give the weight percent of chlorine (42 signifies 42 percent chlorine). Since the physical and chemical properties of each Aroclor vary, the analytical behavior of each Aroclor will also vary. For PCB residue analysis, it is customary to determine the amount of PCB residue found by comparing the residue to a known quantity of the Aroclor it most nearly matches when separated into multicomponents on a gas chromatograph. Therefore, the Commissioner agrees that clarification of the term "PCB" is necessary for the analysis of food, animal feed and paper food-packaging materials for PCB residues. The compilation of FDA analytical methods to be used for enforcing the PCB tolerance that is available upon request contains instructions regarding this aspect of the recommendation. The Commissioner does not agree, however, that the tolerances for PCB's should distinguish between PCB-compounds of different chemical composition because toxicological data do not support the need to establish separate tolerances for each Aroclor. Therefore, the temporary tolerances will apply to the term "PCB" irrespective of which Aroclor or mixture of Aroclor is present as the contaminant.

4. *Section 122.10(a)(1) and (2).* The notice included the proposal to establish a temporary tolerance for PCB's in milk and dairy products at 2.5 ppm (fat basis).

a. One comment recommends that since FDA's previous action level for PCB's in milk and dairy products, which was set at 55 ppm (fat basis), was stated as adequate for protecting public health, the temporary tolerance for milk and dairy products should be kept at the same level. The Commissioner concludes that there is no justification for raising the proposed tolerance from 2.5 ppm to 5 ppm in the fat of milk and dairy products. The 2.5 ppm temporary tolerance takes into account current toxicological data and the level of PCB residues that is presently considered unavoidable. A recent FDA survey revealed that only one sample of milk in 520 tested contained more than 2.5 ppm PCB in the fat, i.e., 0.2 percent of the total samples. Evidence also indicates that higher levels may be generally attributed to avoidable sources of contamination, such as the use of PCB coatings in diary farm silos which caused PCB contamination of silage for diary cows with subsequent transmission of PCB's to the milk of these cows.

b. One comment recommends the PCB tolerance be expressed on an "as is" basis because the fat content of dairy products varies and these foods are consumed "as is". The Commissioner rejects this recommendation. The butterfat is generally considered the most valuable constituent of milk. PCB's are fat soluble, and in the manufacture of various dairy products from milk, remain at a nearly constant concentration in the fat. The fat basis tolerance is therefore necessary to govern the level of PCB's in such products in preparing some other type of food. For example, butter (about 80 percent fat) made from milk containing levels of PCB's below tolerance would also be acceptable since the PCB concentration in the fat would be unchanged.

5. *Section 122.10(a)(3).* The notice included a proposal to establish a temporary tolerance for PCB's in poultry at 5.0 ppm (fat basis).

a. One comment recommends that since FDA's previous action level for PCB's in poultry, which was set at 5 ppm on the edible tissue, was stated as adequate for protecting public health, the temporary tolerance should be kept at that same level. The Commissioner rejects this recommendation. PCB contamination of poultry at levels in excess of the temporary tolerance being established has been attributed to the use of animal feed contaminated with PCB's as a result of industrial accidents, e.g., leakage of PCB's onto feed components. The Commissioner concludes that there is no justification for establishing a tolerance level that accounts for avoidable sources of contamination. The temporary tolerance of 5 ppm (fat basis) takes into account that this level of PCB is generally unavoidable because some poultry feeds contain unavoidable PCB residues that will transfer to and concentrate in the fat of poultry. Furthermore, current toxicological data supports this tolerance level.

b. One comment recommends that the tolerance for poultry be expressed on an "as is basis" since this would more closely relate to the total PCB intake from this food than would a tolerance established for poultry on a "fat basis". In response, the Commissioner finds that although the dietary intake of PCB's resulting from contaminated poultry was considered on an "as is" basis (whole tissue) in the development of the temporary tolerance level, expressing the temporary tolerance on a fat basis is preferred since PCB's are fat soluble and fat derived from poultry can be used as a separate food (e.g., soups, gravies, etc.). The fat basis tolerance, therefore, provides the assurance that poultry contains acceptable levels of PCB's, irrespective of whether the whole tissue is consumed or the fat is consumed as a separate food.

6. *Section 122.10(a)(5) and (6).* The notice included the proposal to establish temporary tolerances for PCB's in finished animal feeds at 0.5 ppm and animal feed components (including fishmeal) at 5 ppm.

a. One comment recommends that the term "finished animal feed" be changed to "complete animal feed" since some finished feeds are further mixed with grains, by-products of grains, and other feed ingredients of plant origin before feeding. The Commissioner agrees that certain finished animal feeds such as feed concentrates, premixes, and supplements, often contain high levels of PCB's because they consist of a high percentage of animal-derived ingredients. At time of use, however, these articles are mixed with plant-derived ingredients which are not expected to contain PCB's. Thus, the final ration for the animal would not contain excessive levels of PCB's. The Commissioner concludes that for purposes of the PCB tolerance for animal feeds, clarification of the term "finished animal feed" is needed rather than a change in terminology. Therefore, the order is amended in § 122.10(a)(5) (21 CFR 122.10) so that the temporary tolerance for PCB's is applicable to finished animal feeds, except feed concentrates, supplements, and premixes.

b. One comment recommends a PCB tolerance of 1.0 ppm be established for animal feed components which are not of animal or marine origin. Since there has been no reported finding of PCB's (other than that which may be due to avoidable contamination during processing, handling, or storage) in animal feed components such as grains and by-products of grains, the Commissioner concludes there is no need at this time to establish a separate tolerance for PCB's in this category of animal feed component.

c. One comment recommends that the term "animal feed components" be qualified by the expression "including fishmeal and concentrates, premixes, and supplements". The Commissioner agrees with this recommendation and the order is amended in § 122.10(a)(6) so that the temporary tolerance for PCB's is applicable to animal feed components of animal origin (including fishmeal and other marine by-products) and animal feed concentrates, premixes and supplements.

d. The Commissioner finds that although there was no comment to change the proposed tolerance levels of 0.5 ppm for finished animal feeds and 5 ppm for animal feed components, current information indicates a lowering of these tolerance levels is warranted for the following reasons:

(1) Data from FDA conducted feeding studies show that the proposed temporary tolerance 0.5 ppm for finished animal feeds is incompatible with the temporary tolerances for poultry. White leghorn hens exposed to a diet containing 0.5 ppm PCB's (Aroclor 1254) for 8 weeks

contained residues in excess of 5 ppm (fat basis) in the muscle (breast and thigh), dissectable fat, and liver of these animals. At a 0.2 ppm feeding level, the concentration of the PCB tissue residues in poultry was less than 5 ppm (fat basis). Data further indicate that continuous feeding of Arocior 1254 at 0.5 ppm from day three to day forty-three post initial egg production can result in PCB residues only slightly less than 0.5 ppm in the eggs.

(2) Data from FDA surveillance programs and from industry reports indicate that PCB levels in finished animal feeds and in animal feed components are generally substantially less than the proposed tolerance limits. (a) Last year FDA conducted a survey of finished animal feeds for PCB's. The survey consisted of 1274 sample examinations representing various categories of animal feeds. The results show that 4.4 percent of the samples contained PCB residues. The highest reported level was 0.6 ppm PCB in feed intended for beef cattle. The average level for all samples tested was less than 0.1 ppm and the average level of the 56 samples that contained reportable levels of PCB's was less than 0.2 ppm. About 1 percent of the samples exceeded 0.2 ppm. (b) Animal feed components of animal and marine origin are expected to contain PCB's as a result of environmental contamination. During the past year, 32 samples of imported fishmeal were examined by FDA for PCB's. The results show that about 37 percent of the samples contained PCB residues. The highest level reported was 0.47 ppm. In addition, 153 fishmeal samples of domestic origin were examined during this period. The results show that about 48 percent of the samples contained PCB residues. The highest level reported was 2.1 ppm and the average was less than 1 ppm. (c) In the fall of 1971, industry conducted a survey of the PCB levels in rendered animal by-products used for feed ingredients such as hydrolyzed feather meal; meat and bone meal; fats and greases; and poultry by-product meal. The results of this survey which were published in "Feedstuffs," issue of July 3, 1972, show that of the 438 samples tested, the highest level of PCB found was 1.8 ppm in fat and greases. The average PCB level for the samples tested was less than 1 ppm. Other data that the FDA has received on the levels of PCB's in rendered animal by-products essentially confirms the results of this industry survey. Therefore, on the basis of the above, the Commissioner concludes that available evidence requires and justifies a reduction in the PCB tolerances for animal feeds and animal feed components. The order is thus amended in § 122.10(a)(5) and (6) to establish temporary tolerances for PCB's in finished feeds at 0.2 ppm and in animal feed components at 2 ppm.

a. One comment recommends that a tolerance of 5 ppm be established for PCB's in pet food. The Commissioner agrees in part with the comment. The proposal to establish a tolerance for animal feed was directed toward food-producing animals because the transmission of PCB's to the edible portion of animals ingesting PCB contaminated feed constitutes a potential hazard to human health. Further, the comment makes a reasonable recommendation since some pets may be able to safely consume levels of PCB's higher than 0.5 ppm. However, on the basis of available toxicological information, there is insufficient data for FDA to establish a tolerance for PCB's in feed for all types of pets and for other non-food producing animals. For this reason, studies will be initiated to obtain this information and, if warranted, FDA will issue a proposal to limit the level of PCB's in this category of finished animal feed. In the interim, the order is amended so that the temporary tolerance in § 122.10(a)(5) is applicable to only food-producing animals.

7. *Section 122.10(a)(7).* The notice included the proposal to establish a temporary tolerance for PCB's in fish (edible portion) at 5 ppm.

a. One comment recommends that a temporary tolerance be established for shellfish. The Commissioner agrees with this recommendation because shellfish also have been found to contain PCB's as a result of unavoidable, environmental contamination and it is also in the interest of public health to limit the level of PCB's in this food. Therefore, § 122.10(a)(7) is amended to include shellfish under the temporary tolerance of 5 ppm.

8. *Section 122.10(a)(8).* The notice included the proposal to establish a temporary tolerance for PCB's in infant and junior foods at 0.1 ppm.

a. One comment states that the level proposed cannot be achieved because of trace quantities of PCB's in certain foods and in paper food-packaging materials. The Commissioner concurs with this statement because information indicates that this level of PCB's cannot be avoided and that current analytical methodology is insufficient to enforce a tolerance of 0.1 ppm. Therefore, the final order is amended by revising the temporary tolerance for PCB's in infant and junior foods to 0.2 ppm.

9. *Section 122.10(a)(9).* The notice included the proposal to establish a temporary tolerance for PCB's in food-packaging materials at 5 ppm.

a. One comment recommends that plastic and other non-paper food-packaging material be exempt from the temporary tolerance. The Commissioner agrees with this recommendation because there is no evidence to indicate that PCB's occur in plastic or other non-paper food-packaging materials as a result of unavoidable contamination. For this reason, no basis exists for establishing a tolerance under Section 406 of the Federal Food, Drug, and Cosmetic Act for these articles. Therefore, the wording of § 122.10(a)(9) is revised to apply only to paper food-packaging materials. This exemption means that no PCB's whatever may be present, either as a result of purposeful addition or industrial accidents, in plastic and other non-paper food-packaging materials. The provisions in the Statement of General Policy or Interpretation under Part 2, which prohibits the use of PCB-containing equipment and materials, are applicable to those establishments engaged in the manufacture, handling, and storage of plastic and other non-paper food-packaging materials.

b. One comment contends that no authority exists under Section 406 of the Federal Food, Drug, and Cosmetic Act for the establishment of temporary tolerances for PCB's in food-packaging materials. The Commissioner concludes that the establishment of temporary tolerances for PCB's in food-packaging material is consistent with the language and purpose of Sections 402(a)(2)(A) and 406 of the Federal Food, Drug, and Cosmetic Act.

c. One comment recommends the temporary tolerance be applied to the packaged food, rather than the food-packaging material. The Commissioner rejects this recommendation for the following reasons:

(1) Since the transfer of PCB's from packaging material to the food is dependent on time and conditions of exposure, tolerances based solely on the food would not provide adequate protection to the consumer. A packaged food analyzed at the time of packaging may be entirely free of PCB's, but by the time it reaches the consumer and is finally consumed it may have accumulated considerable quantities of PCB's if the packaging material is contaminated. A tolerance system in which analytical findings are so dependent on many variables such as time of sampling would not be reasonable or adequate. (2) In order to achieve compliance with a tolerance for packaged food, the level of PCB in the packaging has to be taken into account and limited to preclude the potential transfer of quantities of PCB's to the food that would cause the food to exceed its tolerance level. The fact that the level of PCB in packaged food is related to the level of PCB in its packaging, in effect, necessitate tolerance for both the food and its packaging. This would represent an obvious redundancy. (3) Establishing a tolerance for packaged food would be inconsistent with the intent and meaning of section 406 of the Federal Food, Drug, and Cosmetic Act. The packaged food does not contain unavoidable PCB residues. The principal source of the PCB contamination of packaged food is the paper food-packaging material, which contain the unavoidable contamination. As such, the tolerance should deal with this article. Therefore, this source of food contamination should be limited so as to minimize the levels of PCB's that may migrate to the packaged food. (4) Failure to limit the level of PCB's in food-packaging materials would perpetuate the use of a known, avoidable source of PCB contamination of food.

d. One comment received from industry and related trade associations argues that the temporary tolerance for PCB's in food-packaging materials should be deleted or postponed until: (1) quality control test procedures and adequate analytical methods are developed to regulate production and insure compliance,

and (2) migration rates are established to take into account barrier effects, type of food, and package weight to food weight ratio. In response, the Commissioner finds that: (1) Although a trade association submitted data which they claimed indicates a lack of reliability in analyses of paperboard material, the data failed to show that uniform test methods were employed by the participating laboratories or that these tests were performed by laboratories with demonstrated capabilities in trace residue analysis. Further, an interlaboratory study conducted under the auspices of another trade association using FDA analytical methodology, supports the conclusion that current methodology is adequately sensitive and reproducible from laboratory to laboratory in order to insure compliance with the tolerance. (2) It is recognized that migration rates (actual level of PCB in food resulting from the use of contaminated packaging) are affected by factors such as barriers, type of food, package weight to food weight ratio, and time and conditions of exposure. Since FDA's primary concern is not the fact that paper food-packaging materials contain PCB's, but the fact that PCB's can migrate to the food from the packaging, the use of barriers which prevent migration is an acceptable alternative to limiting the PCB content of paper food-packaging material. For this reason, the final order is amended in § 122.10(a)(9) to exempt paper food-packaging materials from compliance with the temporary tolerance if the paper food-packaging material is separated from the food by a functional barrier impermeable to PCB migration. Metal cans and glass bottles are obvious examples of what constitutes a functional barrier impermeable to PCB migration. Data from industry sponsored studies have shown that materials such as polyvinylidene coated paper and glassine can, to varying degrees, prevent or reduce PCB migration under test conditions which would favor migration. FDA would not object to the use of flexible materials and other materials as barriers provided there is no evidence of migration of PCB's to the food. At this time, however, there is insufficient information for FDA to list as part of the regulation those materials that are considered functional barriers. The other factors mentioned above which affect migration rates may also be important considerations and should be thoroughly studied. In the interim, the temporary tolerance for paper food-packaging materials and the exemption to this temporary tolerance are considered necessary to assure the consumer that packaged food is not being contaminated with PCB's to an avoidable degree.

e. One comment states that the establishment of temporary tolerance for PCB in paper food-packaging materials is unwarranted for public health reasons because available scientific evidence shows that Aroclor 1242 (predominant PCB found in paper) is not persistent and cumulative, and thus will not present a chronic toxicity problem. Although data indicates that some components of Aroclor 1242 are metabolized in biological systems more rapidly than the higher chlorinated Aroclors, there is no information available which describes the composition, toxicity, and fate of the metabolic products. The absence of Aroclor 1242 residues in human and other animal tissue and in the environment is not a sound basis from which to argue that no hazard exists from the ingestion of Aroclor 1242. The possibility exists that Aroclor 1242 is converted to alteration products which may be more toxic than the original compounds, but which are not detectable by current analytical methods. Further, available data from chronic feeding studies with rats and dogs fail to substantiate claims that Aroclor 1242 does not represent a toxic substance or that it differs in toxicity from the higher Aroclors. The Commissioner concludes that the temporary tolerance for paper food-packaging materials will apply to the term "PCB" irrespective of which Aroclor is present as the contaminant.

f. Several manufacturers and trade associations recommended that the temporary tolerance for PCB's in food-packaging materials be modified so that the tolerance is expressed as "0.265 mcg/square centimeter in that portion of the package from which migration to the food can reasonably be expected", rather than using "parts per million" terminology. The Commissioner believes that this would not be a practical alternative because: (1) Expressing the tolerance for the weight of PCB residues in terms of unit area of packaging material rather than unit weight of packaging material assumes that PCB's are uniformly distributed throughout the food package and that any area of the packaging material selected for PCB analysis would be representative of the entire package. It is generally recognized that this assumption is not valid. (2) The migration of PCB from package material to food is considered to be chiefly a vapor phase phenomenon which is related to the concentration of PCB's in the packaging material. It is therefore not possible to ascertain which portion of the package would be expected to contribute to the PCB contamination of the packaged food. For these reasons, it is necessary to take into account the paper food-packaging material in its entirety as a potential source for the PCB contamination of the packaged food. Therefore, expressing the tolerance in terms of weight of PCB's per weight of packaging material as "parts per million" is a practical means to measure the "average" PCB level in the packaging.

g. One comment recommends that FDA include in the final regulation PCB analytical procedures employed by FDA in determining the extent of compliance with the established temporary tolerance for paper food-packaging materials. The Commissioner concurs in part with this recommendation and FDA will provide upon request the analytical methods to be used for enforcing the temporary tolerances for PCB's in paper food-packaging materials and the other articles for which tolerances are established in § 122.10(a). Omitting the methodology from the regulation will permit easier adoption of improved procedures as they are developed while having the analytical methods readily available to all interested parties.

h. One comment states that the temporary tolerance for PCB's for paper food-packaging materials will be detrimental to solid waste disposal programs, increase food packaging costs and result in an insufficient supply of packaging materials due to limitations of raw materials, and thus will significantly affect the quality of the human environment. The underlying basis for this statement is the fact that PCB's may occur in recycled paper because of the inclusion of some types of carbonless copy paper containing 3–5 percent PCB's into wastepaper stocks used in the manufacture of recycled paper. The comment contends that the temporary tolerance will have an adverse effect on the recycled paper industry and thus will cause the above environmental consequences. In response, FDA prepared in accordance with the National Environmental Policy Act of 1969 an environmental impact statement on the proposed rule making. FDA issued a Draft Environmental Impact Statement on May 11, 1972, a Final Environmental Impact Statement on December 21, 1972, and a Supplement to the Final Environmental Impact Statement (published concurrently with this order). In these statements, FDA asserted that information on the toxicity of PCB's necessitates limiting the levels of PCB's currently present in certain foods as a result of environmental contamination, as well as levels of PCB's in certain unavoidable sources of food contamination, i.e., PCB contaminated paper foodpackaging materials. FDA also asserted that the public health benefits derived from the rule making would outweigh any benefits that might be derived from industry-recommended alternative courses of action. These alternatives, which were considered and rejected by FDA as ineffective consumer protection measures, included: (1) The alternative of not regulating the PCB content of food-packaging materials; (2) The alternative of exempting Aroclor 1242 from the regulation; and (3) The alternative of regulating the packaged food rather than the packaging. FDA concluded in the statements that the rule making would have a significant, beneficial effect on the quality of the human environment. FDA did, however, re-evaluate the proposed level of 5 ppm as the temporary tolerance for PCB's in paper food-packaging materials. Data from the FDA survey of PCB's in foods and food packaging showed that the food portion of the samples with 5–10 ppm in paper food packaging contained the same range of PCB levels (0.1–0.6 ppm) as the food portion of the samples with 0–5 ppm in paper packaging. Samples with more than 10 ppm in the packaging contained higher levels in the food, ranging up to 3.7 ppm. The Commissioner concluded that this was the only acceptable alternative available and stated in the Final Environmental Impact Statement that the temporary tolerance for PCB's in paper

food-packaging materials would be changed to 10 ppm. (This order amends § 122.10(a)(9) to reflect this change.) Data provided by industry shows that levels of PCB's in paper food-packaging materials have diminished during the past year to the point that 93 percent or more of this material will contain 10 ppm or less PCB's. Therefore, FDA concluded that the temporary tolerance of 10 ppm and the exemption to this tolerance for paper food-packaging materials separated from the packaged food by a functional barrier will protect the public, while minimizing or negating the impact of the rule making on recycling programs. Furthermore, FDA indicated in the Supplement to the Final Environmental Impact Statement that it will explore with other federal agencies measures for eliminating PCB-containing carbonless copy paper from existing inventories. If feasible, this action would reduce the primary source of PCB's found in paper food-packaging materials permitting FDA to reduce the temporary tolerance, and eventually to eliminate the need for regulating this unavoidable source of PCB's in food.

Accordingly, pursuant to provisions of the Federal Food, Drug, and Cosmetic Act (secs. 402(a), 406, 409, 701, 52 Stat. 1046 as amended, 1049, 1055–1056 as amended by 70 Stat. 919 and 72 Stat. 948, 72 Stat. 1784–1788 as amended; 21 U.S.C. 342(a), 346, 348, 371) and under authority delegated to the Commissioner (21 CFR 2.120) Parts 3, 121, 128, and 135 are amended and a new Part 122 is added, as follows:

PART 3—STATEMENTS OF GENERAL POLICY OR INTERPRETATION

1. The following new section is added to Part 3:

§ 3.93 Use of polychlorinated biphenyls (PCB's) in establishments manufacturing food-packaging materials.

(a) Polychlorinated biphenyls (PCB's) represent a class of toxic industrial chemicals manufactured and sold under a variety of trade names, including: Arocior (United States); Phenoclor (France); Colphen (Germany); and Kanaclor (Japan). PCB's are highly stable, heat resistant, and non-flammable chemicals. Industrial uses of PCB's include, or did include in the past, their use as electrical transformer and capacitor fluids, heat transfer fluids, hydraulic fluids, and plasticizers, and in formulations of lubricants, coatings, and inks. Their unique physical and chemical properties and widespread, uncontrolled industrial applications have caused PCB's to be a persistent and ubiquitous contaminant in the environment, causing the contamination of certain foods. In addition, incidents have occurred in which PCB's have directly contaminated animal feeds as a result of industrial accidents (leakage or spillage of PCB fluids from plant equipment). These accidents in turn caused the contamination of food products intended for human consumption (meat, milk and eggs). Investigations by the Food and Drug Administration have revealed that a significant percentage of paper food-packaging material contains PCB's which can migrate to the packaged food. The origin of PCB's in such material is not fully understood. Reclaimed fibers containing carbonless copy paper (contains 3 to 5 percent PCB's) have been identified as a primary source of PCB's in paper products. Some virgin paper products have also been found to contain PCB's, the source of which is generally attributed to direct contamination from industrial accidents from the use of PCB-containing equipment and machinery in food packaging manufacturing establishments. Since PCB's are toxic chemicals, the PCB contamination of food-packaging materials as a result of industrial accidents, which can cause the PCB contamination of food, represents a hazard to public health. It is therefore necessary to place certain restrictions on the industrial uses of PCB's in establishments manufacturing food-packaging materials.

(b) The following special provisions are necessary to preclude the accidental PCB contamination of food-packaging materials:

(1) New equipment or machinery for manufacturing food-packaging materials shall not contain or use PCB's.

(2) On or before August 6, 1973, the management of establishments manufacturing food-packaging materials shall:

(i) Have the heat exchange fluid used in existing equipment for manufacturing food-packaging materials sampled and tested to determine whether it contains PCB's or verify the absence of PCB's in such formulations by other appropriate means. On or before Sept. 4, 1973, any such fluid formulated with PCB's must to the fullest extent possible commensurate with current good manufacturing practices be replaced with a heat exchange fluid that does not contain PCB's.

(ii) Eliminate to the fullest extent possible commensurate with current good manufacturing practices from the establishment any other PCB-containing equipment, machinery and materials wherever there is a reasonable expectation that such articles could cause food-packaging materials to become contaminated with PCB's either as a result of normal use or as a result of accident, breakage, or other mishap.

(iii) The toxicity and other characteristics of fluids selected as PCB replacements must be adequately determined so that the least potentially hazardous replacement is used. In making this determination with respect to a given fluid, consideration should be given to (a) its toxicity; (b) the maximum quantity that could be spilled onto a given quantity of food before it would be noticed, taking into account its color and odor; (c) possible signaling devices in the equipment to indicate a loss of fluid, etc.; and (d) its environmental stability and tendency to survive and be concentrated through the food chain. The judgment as to whether a replacement fluid is sufficiently non-hazardous is to be made on an individual installation and operation basis.

(c) The provisions of this section do not apply to electrical transformers and condensers containing PCB's in sealed containers.

PART 121—FOOD ADDITIVES

2. In Part 121, § 121.2546(b) is amended by revising subparagraphs (1) and (2), as follows:

§ 121.2546 Pulp from reclaimed fiber.

* * * * *

(b) * * *

(1) Industrial waste from the manufacture of paper and paperboard products excluding that which bears or contains any poisonous or deleterious substance which is retained in the recovered pulp and that migrates to the food, except as provided in regulations promulgated under sections 406 and 409 of the Federal Food, Drug, and Cosmetic Act.

(2) Salvage from used paper and paperboard excluding that which (i) bears or contains any poisonous or deleterious substance which is retained in the recovered pulp and that migrates to the food, except as provided in regulations promulgated under sections 406 and 409 of the act or (ii) has been used for shipping or handling any such substance.

* * * * *

PART 122—UNAVOIDABLE CONTAMINANTS IN FOOD AND FOOD-PACKAGING MATERIAL

3. A new Part 122 is added as follows:

Subpart A—Definitions and Procedural and Interpretive Regulations

Sec.
122.1 Definitions and interpretations.
122.2—122.9 [Reserved]

Subpart B—Industrial Contaminants in Food and Food-Packaging Material

122.10 Temporary tolerances for polychlorinated biphenyls (PCB's).

AUTHORITY: Secs. 402(a), 406, 409, 701, 52 Stat. 1046 as amended, 1049, 1055–1056 as amended by 70 Stat. 919 and 72 Stat. 948, 72 Stat. 1785–1788 as amended; 21 U.S.C. 342(a), 346, 348, 371.

Subpart A—Definitions and Procedural and Interpretive Regulations

§ 122.1 Definitions and interpretations.

(a) The definitions and interpretations of terms contained in section 201 of the Federal Food, Drug, and Cosmetic Act shall be applicable to such terms when used in this part.

(b) Unavoidable natural, environmental, or industrial contaminants include any poisonous or deleterious substance added to any food where such substance cannot be avoided by good manufacturing practice.

Subpart B—Industrial Contaminants in Food and Food-Packaging Material

§ 122.10 Temporary tolerances for polychlorinated biphenyls (PCB's).

(a) Polychlorinated biphenyls (PCB's) are toxic, industrial chemicals. Because of their widespread, uncontrolled industrial applications, PCB's have become a persistent and ubiquitous contaminant in

the environment. As a result, certain foods and animal feeds, principally those of animal and marine origin, contain PCB's as unavoidable, environmental contaminants. PCB's are transmitted to the food portion (meat, milk, and eggs) of food producing animals ingesting PCB contaminated animal feed. In addition, a significant percentage of paper food-packaging materials contain PCB's which may migrate to the packaged food. The source of PCB's in paper food-packaging materials is primarily of certain types of carbonless copy paper (containing 3 to 5 percent PCB's) in waste paper stocks used for manufacturing recycled paper. Therefore, temporary tolerances for residues of PCB's as unavoidable environmental or industrial contaminants are established for a sufficient period of time following the effective date of this paragraph to permit the elimination of such contaminants at the earliest practicable time. For the purposes of this paragraph, the term "polychlorinated biphenyls (PCB's)" is applicable to mixtures of chlorinated biphenyl compounds, irrespective of which mixture of PCB's is present as the residue. The temporary tolerances for residues of PCB's are as follows:

(1) 2.5 parts per million in milk (fat basis).

(2) 2.5 parts per million in manufactured dairy products (fat basis).

(3) 5 parts per million in poultry (fat basis).

(4) 0.5 parts per million in eggs.

(5) 0.2 parts per million in finished animal feed for food-producing animals (except the following finished animal feeds: feed concentrates, feed supplements, and feed premixes).

(6) 2 parts per million in animal feed components of animal origin, including fishmeal and other by-products of marine origin and in finished animal feed concentrates, supplements, and premixes intended for food producing animals.

(7) 5 parts per million in fish and shellfish (edible portion). The edible portion of fish excludes head, scales, viscera, and inedible bones.

(8) 0.2 parts per million in infant and junior foods.

(9) 10 parts per million in paper food-packaging material intended for or used with human food, finished animal feed and any components intended for animal feeds. The tolerance shall not apply to paper food-packaging material separated from the food therein by a functional barrier which is impermeable to migration of PCB's.

(b) A compilation entitled "Analytical Methodology for Polychlorinated Biphenyls, February 1973" for determining compliance with the tolerances established in this section is available from the Hearing Clerk, Department of Health, Education, and Welfare, Room 6-88, 5600 Fishers Lane, Rockville, MD 20852.

PART 128—HUMAN FOODS; CURRENT GOOD MANUFACTURING PRACTICE (SANITATION) IN MANUFACTURE, PROCESSING, PACKING OR HOLDING

4. In Part 128 by revising § 128.4 to read as follows:

§ 128.4 Equipment and utensils.

(a) *General.* All plant equipment and utensils should be (1) suitable for their intended use, (2) so designed and of such material and workmanship as to be adequately cleanable, and (3) properly maintained. The design, construction, and use of such equipment and utensils shall preclude the adulteration of food with lubricants, fuel, metal fragments, contaminated water, or any other contaminants. All equipment should be so installed and maintained as to facilitate the cleaning of the equipment and of all adjacent spaces.

(b) *Use of polychlorinated biphenyls in food plants.* Polychlorinated biphenyls (PCB's) represent a class of toxic industrial chemicals manufactured and sold under a variety of trade names, including: Arocior (United States); Phenoclor (France); Colphen (Germany); and Kanaclor (Japan). PCB's are highly stable, heat resistant, and non-flammable chemicals. Industrial uses of PCB's include, or did include in the past, their use as electrical transformer and capacitor fluids, heat transfer fluids, hydraulic fluids, and plasticisers, and in formulations of lubricants, coatings, and inks. Their unique physical and chemical properties and widespread, uncontrolled industrial applications have caused PCB's to be a persistent and ubiquitous contaminant in the environment and causing the contamination of certain foods. In addition, incidents have occurred in which PCB's have directly contaminated animal feeds as a result of industrial accidents (leakage or spillage of PCB fluids from plant equipment). These accidents in turn cause the contamination of food intended for human consumption (meat, milk, and eggs). Since PCB's are toxic chemicals, the PCB contamination of food as a result of these accidents represents a hazard to human health. It is therefore necessary to place certain restrictions on the industrial uses of PCB's in the production, handling, and storage of food. The following special provisions are necessary to preclude accidental PCB contamination of food:

(1) New equipment, utensils, and machinery for handling or processing food in or around a food plant shall not contain PCB's.

(2) On or before September 4, 1973, the management of food plants shall:

(i) Have the heat exchange fluid used in existing equipment or machinery for handling or processing food sampled and tested to determine whether it contains PCB's, or verify the absence of PCB's in such formulations by other appropriate means. On or before Sept. 4, 1973, any such fluid formulated with PCB's must be replaced with a heat exchange fluid that does not contain PCB's.

(ii) Eliminate from the food plant any PCB-containing food-contact surfaces of equipment or utensils and any PCB-containing lubricants for equipment or machinery that is used for handling or processing food.

(iii) Eliminate from the food plant any other PCB-containing materials wherever there is a reasonable expectation that such materials could cause food to become contaminated with PCB's either as a result of normal use or as a result of accident, breakage, or other mishap.

(iv) The toxicity and other characteristics of fluids selected as PCB replacements must be adequately determined so that the least potentially hazardous replacement is used. In making this determination with respect to a given fluid, consideration should be given to (a) its toxicity; (b) the maximum quantity that could be spilled onto a given quantity of food before it would be noticed, taking into account its color and odor; (c) possible signaling devices in the equipment to indicate a loss of fluid, etc.; and (d) its environmental stability and tendency to survive and be concentrated through the food chain. The judgment as to whether a replacement fluid is sufficiently non-hazardous is to be made on an individual installation and operation basis.

(3) For the purposes of this section, the provisions do not apply to electrical transformers and condensers containing PCB's in sealed containers.

PART 135—NEW ANIMAL DRUGS

5. The following new section is added to Part 135, Subpart B:

§ 135.113 Use of polychlorinated biphenyls (PCB's) in the production, handling, and storage, of animal feed.

(a) Polychlorinated biphenyls (PCB's) represent a class of toxic industrial chemicals manufactured and sold under a variety of trade names, including: Arocior (United States); Phenoclor (France); Colphen (Germany); and Kanaclor (Japan). PCB's are highly stable, heat resistant, and nonflammable chemicals. Industrial uses of PCB's include, or did include in the past, their use as electrical transformer and capacitor fluids, heat transfer fluids, hydraulic fluids, plasticisers, and in formulations of lubricants, coatings, and inks. Their unique physical and chemical properties and widespread, uncontrolled industrial applications have caused PCB's to be a persistant and ubiquitous contaminant in the environment, causing the contamination of certain foods. In addition, incidents have occurred in which PCB's have directly contaminated animal feeds as a result of industrial accidents (leakage or spillage of PCB fluids from plant equipment). These accidents in turn cause the contamination of food intended for human consumption, (meat, milk, and eggs). Investigations by the Food and Drug Administration have revealed that heat exchange fluids for certain pasteurization equipment used in processing animal feed contain PCB's. Although heat exchange fluids in such equipment are considered to be in "closed systems", leakage has occurred that resulted in direct contamination of animal feed with PCB's and subsequently resulted in the transfer of PCB's to human food produced by animals consuming the contaminated feed. The use of PCB-containing coatings on the inner walls of silos has resulted in the contamination of silage which has in turn caused PCB

residues in the milk of dairy cows consuming the contaminated silage. Since PCB's are toxic chemicals, the PCB contamination of food as a result of these and other incidents represent a hazard to public health. It is therefore necessary to place certain restrictions on the industrial uses of PCB's in the production, handling, and storage of animal feed.

(b) The following special provisions are necessary to preclude accidental PCB contamination of animal feed:

(1) Coatings or paints for use on the contact surfaces of feed storage areas may not contain PCB's or any other harmful or deleterious substances likely to contaminate feed.

(2) New equipment or machinery for handling or processing feed in or around an establishment producing animal feed shall not contain PCB's.

(3) On or before Sept. 4, 1973, the management of establishments producing animal feed shall:

(i) Have the heat exchange fluid used in existing equipment or machinery for handling and processing feed sampled and tested to determine whether it contains PCB's, or verify the absence of PCB's in such formulations by other appropriate means. On or before Sept. 4, 1973, any such fluid formulated with PCB's must to the fullest extent possible commensurate with current good manufacturing practices, be replaced with a heat exchange fluid that does not contain PCB's.

(ii) Eliminate to the fullest extent possible commensurate with current good manufacturing practices from the animal feed producing establishment any PCB-containing lubricants for equipment or machinery used for handling or processing animal feed.

(iii) Eliminate to the fullest extent possible commensurate with current good manufacturing practices from the animal feed producing establishment any other PCB-containing materials, whenever there is a reasonable expectation that such materials could cause animal feed to become contaminated with PCB's either as a result of normal use or as a result of accident, breakage, or other mishap.

(iv) The toxicity and other characteristics of fluids selected as PCB replacements must be adequately determined so that the least potentially hazardous replacement should be used. In making this determination with respect to a given fluid, consideration should be given to (a) its toxicity; (b) the maximum quantity that could be spilled onto a given quantity of food before it would be noticed, taking into account its color and odor; (c) possible signaling devices in the equipment to indicate a loss of fluid, etc.; (d) and its environmental stability and tendency to survive and be concentrated through the food chain. The judgment as to whether a replacement fluid is sufficiently non-hazardous is to be made on an individual installation and operation basis.

(c) For the purpose of this section, the provisions do not apply to electrical transformers and condensers containing PCB's in sealed containers.

(d) For the purpose of this section, the term "animal feed" includes all articles used for food or drink for animals other than man.

Any person who will be adversely affected by the provisions of §§ 121.2548 and 122.10 of the foregoing order may at any time on or before August 6, 1973 file with the Hearing Clerk, Department of Health, Education, and Welfare, Room 6-88, 5600 Fishers Lane, Rockville, MD 20852, written objections thereto. Objections shall show wherein the person filing will be adversely affected by the order, specify with particularity the provisions of the order deemed objectionable, and state the grounds for the objections. If a hearing is requested, the objections shall states the issues for the hearing, shall be supported by grounds factually and legally sufficient to justify the relief sought, and shall include a detailed description and analysis of the factual information intended to be presented in support of the objections in the event that a hearing is held. Objections may be accompanied by a memorandum or brief in support thereof. Six copies of all documents shall be filed. Received objections may be seen in the above office during working hours, Monday through Friday.

Effective date. This order will become effective for foods, feeds, and paper food-packaging materials initially shipped in commerce after Sept. 4 1973 except as to any provisions of §§ 121.2546 and 122.10 that may be stayed by the filing of proper objections. Notice of the filing of objections or lack thereof will be announced in the FEDERAL REGISTER. In the event § 122.10 is stayed by valid objections, pending a final regulation the Food and Drug Administration will enforce the levels stated in § 122.10 by seizing pursuant to sections 301 and 304 of the Act any food, feed, or paper food-packaging material shipped in commerce containing higher than the specified level of PCB's as adulterated in violation of section 402 of the Act.

(Secs. 402(a), 406, 409, 701, 52 Stat. 1046 as amended, 1049, 1055–1056 as amended by 70 Stat. 919 and 72 Stat. 948, 72 Stat. 1785–1788 as amended; 21 U.S.C. 342(a), 346, 348, 371)

Dated: June 21, 1973.

SHERWIN GARDNER,
Acting Commissioner of Food and Drugs.

[FR Doc.73-13548 Filed 7-5-73;8:45 am]

ROC# 00064

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Food and Drug Administration

POLYCHLORINATED BIPHENYLS

Availability of Supplement To Final Environmental Impact Statement

The Commissioner of Food and Drugs published a notice in the FEDERAL REGISTER of December 21, 1972 (37 FR 28201) announcing that a statement entitled "Final Environmental Impact Statement—Rule Making on Polychlorinated Biphenyls" had been issued by the Food and Drug Administration.

Notice is hereby given that a statement entitled "Supplement to the Final Environmental Impact Statement—Rule Making on Polychlorinated Biphenyls" has been issued by the Food and Drug Administration. Copies of the supplement are available from the Office of the Assistant Commissioner for Public Affairs, Room 15B-42, or the Office of the Hearing Clerk, Room 6-88, 5600 Fishers Lane, Rockville, MD 20852.

This notice is issued pursuant to provisions of the National Environmental Policy Act of 1969, Public Law 91-190 (sec. 102(2)(c), 83 Stat. 853; 42 U.S.C. 4332), and under authority delegated to the Commissioner (21 CFR 2.120).

Dated: June 21, 1973.

SAM D. FINE,
Associate Commissioner for Compliance.

[FR Doc.73-13548 Filed 7-5-73;8:45 am]

Monsanto

Classified as to fire hazard only.

PYDRAUL. F-9

THE SAFETY HYDRAULIC FLUID

CAUTION!

CONTAINS CHLORINATED HYDROCARBONS.

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water.

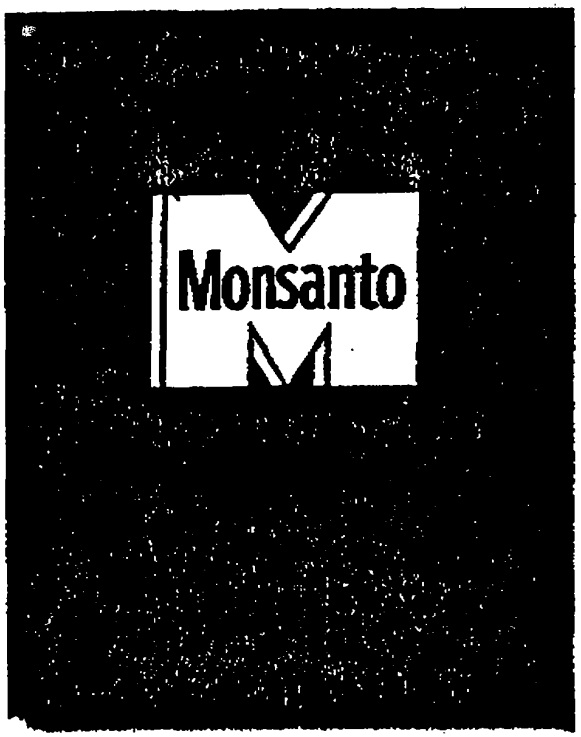
If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER **55 U.S. Gallons**

NET LEGAL	**590** LBS.	**267.62** KILOS	TARE	48 LBS.	21.77 KILOS
			GROSS	638 LBS.	289.39 KILOS

MONSANTO COMPANY, ST. LOUIS, MISSOURI, U.S.A. 804.05-009.09/53

ROCH 00141



PYDRAUL F-9

THE SAFETY HYDRAULIC FLUID

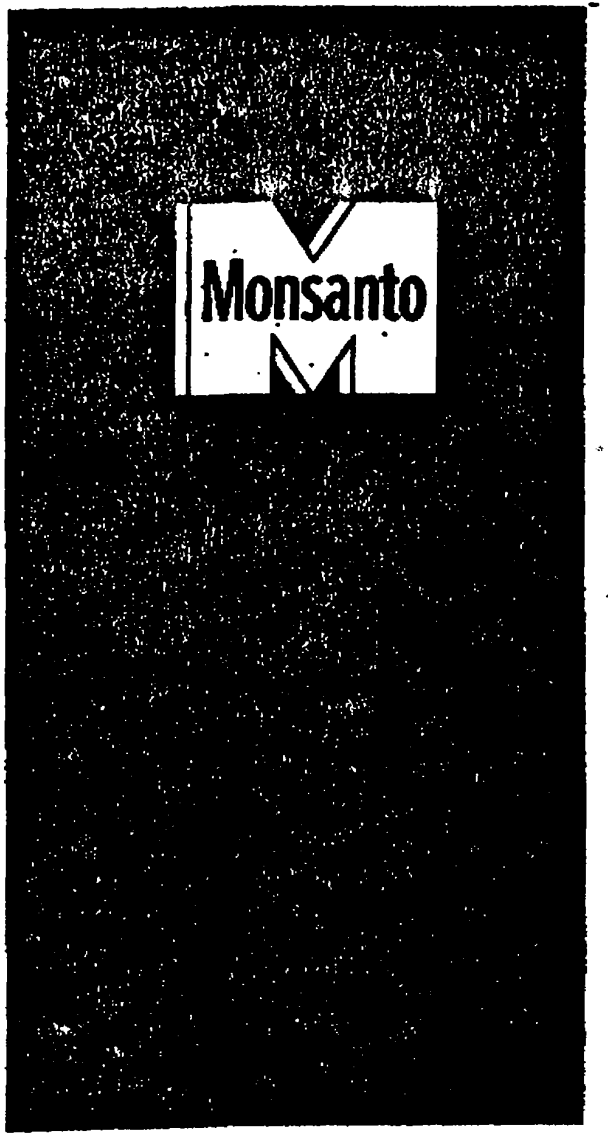
CAUTION: Contains chlorinated hydrocarbons. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water. If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER

55 U.S. Gallons

NET LEGAL **590** LBS.	**267.62** KILOS	TARE	48 LBS.	21.77 KILOS
		GROSS	638 LBS.	289.39 KILOS

MONSANTO COMPANY ST. LOUIS MISSOURI U.S.A. 808 05 009 12/53



PYDRAUL® 312

THE SAFETY HYDRAULIC FLUID

CAUTION!

CONTAINS CHLORINATED HYDROCARBONS.

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water.

If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER

54 U.S. Gallons

NET LEGAL	**495** LBS.	**224.53** KILOS	TARE	48 LBS.	21.77 KILOS
			GROSS	543 LBS.	246.30 KILOS

MONSANTO COMPANY, ST. LOUIS, MISSOURI, U.S.A. 808.86-312.01/53

ROCH 00143

PYDRAUL® 312

THE SAFETY HYDRAULIC FLUID

CAUTION!

CONTAINS CHLORINATED HYDROCARBONS.

Avoid prolonged breathing of vapors or mists.

Avoid contact with eyes or prolonged contact with skin.

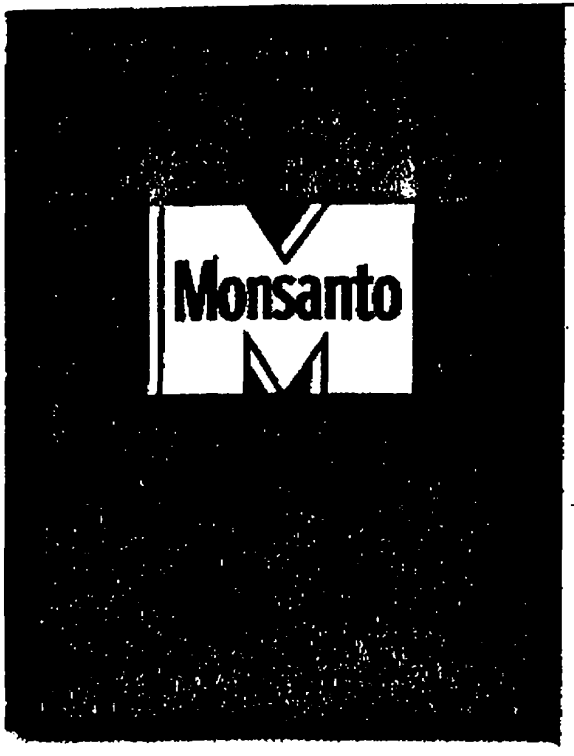
If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water.

If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER

54 U.S. Gallons

TARE 48 LBS. 21.77 KILOS



PYDRAUL 312

THE SAFETY HYDRAULIC FLUID

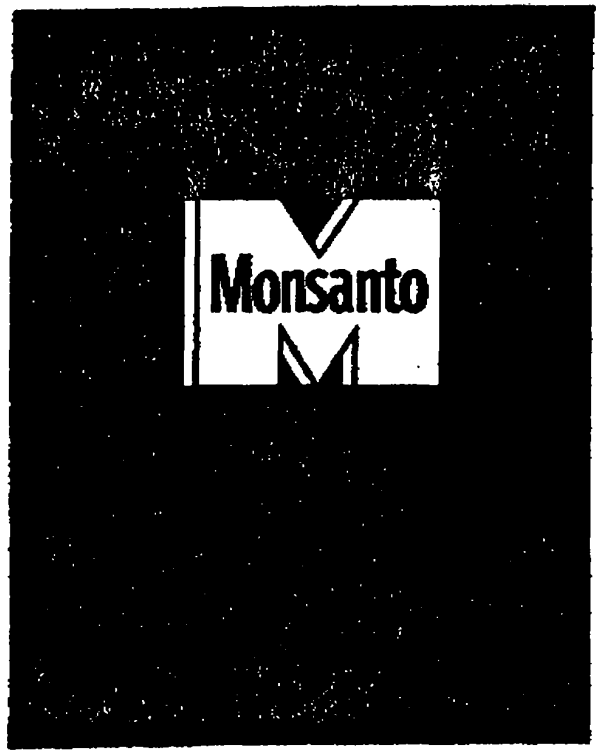
CAUTION: Contains chlorinated hydrocarbons. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water. If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER

54 U.S. Gallons

NET LEGAL **500** LBS.	**226.80** KILOS	TARE	48 LBS.	21.77 KILOS
		GROSS	548 LBS.	248.57 KILOS

MONSANTO COMPANY, ST. LOUIS, MISSOURI, U.S.A. 808.86-312.06/53



JUN 2 1963

PYDRAUL 312

THE SAFETY HYDRAULIC FLUID

CAUTION: Contains chlorinated hydrocarbons. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water. If clothing becomes soaked with fluid, launder before wearing again.

LOT NO. _____ PACKER

54 U.S. Gallons

NET LEGAL **500** LBS.	**226.80** KILOS	TARE	48 LBS.	21.77 KILOS
		GROSS	548 LBS.	248.57 KILOS

MONSANTO COMPANY, ST. LOUIS, MISSOURI, U.S.A. 308.86-312.06/

ROCK 00146

PYDRAUL 312 A

THE SAFETY HYDRAULIC FLUID

CAUTION: Contains chlorinated hydrocarbons. Avoid prolonged breathing of vapors or mists. Avoid contact with eyes or prolonged contact with skin. If skin contact occurs, remove by washing with soap and water. Following eye contact flush with water. If clothing becomes soaked with fluid, launder before wearing again.

LOT NO._____PACKER

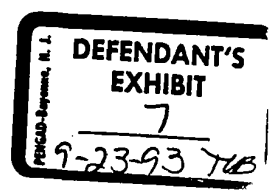
54 U.S. Gal.	NET/LEGAL	500 LB.	226.80 KG.
	TARE	48 LB.	21.77 KG.
	GROSS	548 LB.	248.57 KG.

MONSANTO COMPANY, ST. LOUIS, MISSOURI 63166, U.S.A. 804.60-313.02/53

This product contains polychlorinated biphenyls, which some studies have shown may be an environmental contaminant. Extreme care should be taken to prevent any entry into the environment through spills, leakage, use, disposal, vaporization or otherwise.

1020/53

ROCW 00267



IMPORTANT

This product contains POLYCHLORINATED BIPHENYLS (PCB's) which some studies have shown may be persistent, an environmental contaminant and possibly injurious to certain forms of bird, aquatic and animal life. Prevent any entry into the environment through spills, leakage, disposal, vaporization, re-use of containers or otherwise. Spill, leakage and waste product must be collected.

During shipment avoid spillage and leakage into inland waterways and the sea.

Keep away from food, animal foodstuffs and pharmaceuticals.

DEFENDANT'S EXHIBIT 8 9-23-93 HL

ROCW 00268

CB 2[illegible] REV. 4-69
\9-69

Monsanto

INV
Div Sales

73

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434078	CINN	06-08-70	59-04656	06-08-70	SL 6- 1242

TERMS: NET 30 DAYS — 06-08-70 — CAR INITIALS AND NO.

PREPAID OR COLLECT—ROUTING: PPD GULF DISTRIBUTORS TRUCK

DELIVERY F. O. B.: ST LOUIS MINF/PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST. CODE	
RUSSELLVILLE	1060	1132	2-1-2		02-020-626067

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42.76

SHIP TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
9 54 GAL DRUM -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 B 4500. *	486. GL	2.60 G	1263.60

BERRY
AG

SHIPPING DATE | ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCW 00121

PENGAD-Bayonne, N. J.
DEFENDANT'S EXHIBIT
9
9-23-93 TK

Monsanto

INV
Dir Sales

33

SHIPPER'S NO.	SHIPPED	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434077	CINN	05-08-70	50-04373	05-05-70	SL 8- 1163

CAR INITIALS AND NO

TERMS: NET 30 DAYS — 05-05-70

PREPAID OR COLLECT—ROUTING: PPD GULK BIST TRUCK

DELIVERY F O B: STLOUISMIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST. FORM	
RUSSELVILLE KY	1860	1132	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO:
SAME

0225-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
K 10 SH GL DRMS -030 HYDRAUL 312 2-H-1-6760-312-11-0001-02-01 SHIP -5000. *	5HD. GL	2.55 U	1377.00

BLARY
BMG

SHIPPING DATE	ARRIVAL DATE

DISTRIBUTION - PLEASE

ROCW 00122

CS 200 REV. 4-69
1F 69
165

Monsanto

INV
Div Sales

SHIPPER'S NO.	DELIVERY	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434625	C INN	03-31-70	59 03 [illegible]	03-25-70	SL 3-5727

TERMS: NET 30 DAYS — 03-25-70 — CAR INITIALS AND NO

PREPAID OR COLLECT—ROUTING: PPD GULF DISTRIBUTOR TRUCK

DELIVERY F.O.B.: ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1132	2-1-8		02-020-62 8067

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

02 86-141-16-0-A-1006762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GALLON DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00

BERRY
FM

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCH 00123

CB 200 REV. 4-69

Monsanto

INV

Div Sales

101

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434622	C1MN	03-06-70	39-03668	03-02-70	SL 3- 1351

TERMS		CAR INITIALS AND NO
NET 30 DAYS	03-02-70	

PREPAID OR COLLECT—ROUTING

PPD GULR DISTRIBUTORS TRUCK

DELIVERY F O B

ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1132	2-1-2		02-020-628087

SOLD TO

ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO

SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GALLON DRMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55 M	1377.00
BERRY MG			

SHIPPING DATE	ARRIVAL DATE

ROCH 00124

CB 700 REV. 4-69
M 9-69

Monsanto

INV
Dir Sales

48

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434618	CINN	01-23-70	59-32327	01-21-70	SL 1- 3475

TERMS: NET 30 DAYS — 01-21-70 — CAR INITIALS AND NO

PREPAID OR COLLECT—BUYING: PPD GULF DISTRIBUTORS TRUCK

DELIVERY F.O.B.: ST LOUIS MIN F/PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1132	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 55 GAL DRUM -030 HYDRAUL 312 2-M-1-8760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00
BERRY AG			

SHIPPING DATE	ARRIVAL DATE

ROCW 00125

CB 200 REV. 4-69
OM 2-70

Monsanto

INV
Dir Sales

41

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434084	C DMN	07-31-70	59-05133	08-12-70	SL 8-1134

TERMS: NET 30 DAYS — CAR INITIALS AND NO: 07-31-70

PREPAID OR COLLECT—ROUTING: PPD - GULF [illegible] TRUCK - DISTRIBUTORS TRUCK

DELIVERY F. O. B.: ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST. FORMS
RUSSELLVILLE KY	1860	1138	2-1-2	02-020-62 6287

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

02 25-141-16-2-A-1036762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GALLON DRUMS -030 HYDRAUL 312 2-M-1-6763-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00

BERRY
JS

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS:

ROCW 00126

CB - 0 REV. 4-69
M 2-70

Monsanto

INV

Dir Sales

75

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434085	CINN	08-11-70	59-05194	08-07-70	SL 8- 1407

TERMS: NET 30 DAYS — 08-07-70 — CAR INITIALS AND NO

PREPAID OR COLLECT—ROUTING: PPD GULF DISTRIBUTORS TRK

DELIVERY F O B: ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1132	2-1-2		02-020-628057

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GAL DRMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. #	540. GL	2.55 U	1377.00
CA BERRY-38			

SHIPPING DATE | ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCH 00127

CB [illegible] REV. 4-69
2-70

Monsanto

INV

Dir Sale

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434080	CINN	06-25-70	5904865	06-23-70	SL 6- 4176

TERMS: NET 30 DAYS — CAR INITIALS AND NO.

PREPAID OR COLLECT—ROUTING: 06-23-70

DELIVERY F.O.B.: PPD GULF DIST TRK

ST LOUISMIN FRT PPD

SHIPPED FROM	WIRE CODE	BOOKED THRU	COPIES CODE	CUST. FORM	
RUSSELLVILLE KY	1960	1132	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GAL DRMS -050 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00
CA BERRY-38			

SHIPPING DATE | ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCW 00128

M 2-70

MONSANTO

INV
Dis Sales

34

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434088	CINN	08-15-70	57-05243	08-11-70	SL 8- 2021

TERMS	CAR INITIALS AND NO
NET 30 DAYS 08-11-70	

PREPAID OR COLLECT—ROUTING
PPD GULK DIST TRUCK

DELIVERY F.O.B.
ROSX ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE. CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1060	1132	2-1-2		02-020-628087

SOLD TO
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO
SAME

0275-141-16-0-A-10069762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GL DRMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55 L	1377.00
BERRY NC			

SHIPPING DATE	ARRIVAL DATE

INSTRUCTIONS

ROCW 00129

CB 200 REV. 4-69
80M 2-70

Monsanto

INV
Dir Sale

1

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND	INVOICE NUMBER
233132	C INN	09-23-70	30 05633	09-23-70	SL 9-4311

TERMS		CAR INITIALS AND NO
NET 30 DAYS	09-23-70	

PREPAID OR COLLECT-ROUTING
PPD GULF TRUCK

DELIVERY F.O.B.
ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1060	1132	2-1-2		02-020-628087

SOLD TO
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO
SAME

0296-141-16-0-A-1006876

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GALLON DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000.	540. GL	2.55 U	1377.00
BERRY FM			

SPECIAL INSTRUCTIONS

SHIPPING DATE	ARRIVAL DATE

ROCW 00130

CB 200 REV. 4-69
80M 2-70

Monsanto

INV
Div Sales

97

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
434088		09-04-70	59-05486	09-04-70	SL 9- 1267

TERMS
NET 30 DAYS 09-0470

CAR INITIALS AND NO

PREPAID OR COLLECT—ROUTING
PPD GULF DISTRIBUTORS TRUCK

DELIVERY F.O.B.
ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST. FORM	
RUSSELLVILLE KY	1860	1132	2-1-2		02-020-628087

SOLD TO
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GAL DRUMS -030 PYDRAUL 312 2-M-1-0760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00
BERRY JD			

SPECIAL INSTRUCTIONS

SHIPPING DATE	ARRIVAL DATE

ROCH 00131

WATER_PCB-SD0000058736

200 REV. 4-69
BOM 2-70

Monsanto

INV

Div Sales

91

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO.	INVOICE AND SHIPPING DATE	INVOICE NUMBER
233134	GINN	10-15-70	59-05776	10-12-70	SL 10- 8332

TERMS: NET 30 DAYS — 10-12-70 — CAR INITIALS AND NO.

PREPAID OR COLLECT—ROUTING: PPD GULF DISTRIBUTORS TRUCK

DELIVERY F O B: ST LOUIS MIN F/PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST. FORM	
RUSSELL VILLE KY	1860	1132	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP-PED TO:
SAME

0295-141-16-3-A-1006876

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GAL DRUM -030 PYDFAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00
BERRY AG			

SHIPPING DATE | ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCH 00132

CB 200 7-70

Monsanto

INV

DIV SALES

54

SHIPPER'S NO	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
233160	CINN	01-25-71	59-06608	01-28-71	SL 1- 3537

TERMS: NET 30 DAYS — 01-28-71 — CAR INITIALS AND NO:

PREPAID OR COLLECT – ROUTING: PPD - GULF DISTR TRUCK

DELIVERY F O B: ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE	1860	1132	2-1-2		02-020-628097

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO:
SAME

0295-141-16-0-A-1006870

DESCRIPTION	QUANTITY	PRICE & UNIT		AMOUNT
10 -54 GAL DRUMS -030 HYDRAUL 312 2-14-1-6760-312-11-0001-02-01 5000. *	540.	GL 2.55	U	1377.00

BERRY
JS

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCK 00133

Monsanto

INV

DIV SALES

SHIPPER'S NO.	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
233163		03-05-71	59-07263	04-14-71	SL 4- 1635

TERMS: NET 30 DAYS — 03-25-71

CAR INITIALS AND NO

PREPAID OR COLLECT—ROUTING: PPD GULF DISTRIBUTORS TRK

DELIVERY FOB: ST LOUIS MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1178	2-1-2		02-020-626087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO:
SAME

0295-141-16-0-A-10009762

DESCRIPTION	QUANTITY	PRICE & UNIT		AMOUNT
10 54 GAL DRMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540.	GL 2.55	U	1377.00
CA				

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCW 00134

CB 200
REV 7-70

Monsanto

INV

DIV SALES

35

SHIPPER'S NO	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
412004		06-23-71	59-08096	07-20-71	SL 7-1928

TERMS: NET 30 DAYS — 06-23-71

CAR INITIALS AND NO:

PREPAID OR COLLECT - ROUTING: PPD GULF DISTRB TRK

DELIVERY F O B: ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1178	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT		AMOUNT
4 54 GL DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 2000. *	216. GL	2.55	U	550.80
6 54 GL DRUMS -030 PYDRAUL 312-A 2-M-1-6761-313-11-0001-02-01 3000. *	324. GL	2.55	U	826.20
MT				1377.00T

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCH 00135

CB 30 REV 7

Monsanto

INV

DIV SALES

36

SHIPPER'S NO	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
412002		06-08-71	59-07963	07-20-71	SL 7- 1926

TERMS: NET 30 DAYS

CAR INITIALS AND NO: 06-08-71

PREPAID OR COLLECT—ROUTING: FFD GULF DISTRIB TRK

DELIVERY F.O.B.: ST LOUIS MO MIN FRT FPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1178	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO:
SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT		AMOUNT
10 54 GL DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540. GL	2.55	U	1377.00
MT				

SHIPPING DATE	ARRIVAL DATE

ROCW 00136

CB 200
REV 7-71

Monsanto

INV

DIV SALES

81

SHIPPER'S NO	DISTANCE	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPMENT DATE	INVOICE NUMBER
412000		05-17-71	59-07794	07-16-71	SL 7- 1461

TERMS	CAR INITIALS AND NO
NET 30 DAYS 05-17-71	

PREPAID OR COLLECT – ROUTING
PPD GULF DISTR TRK

DELIVERY F O B
ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1178	2-1-2		02-020-628087

SOLD TO
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO
SAME

0295-141-16-U-A-10668762

DESCRIPTION	QUANTITY		PRICE & UNIT		AMOUNT
2 54 GL DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 1000. *	108.	GL	2.55	U	275.40
8 54 GL DRUMS -030 PYDRAUL 312-A 2-M-1-6761-313-11-0001-02-01 4000. *	432.	GL	2.55	U	1101.60
MT GORDON					
					1377.00T

SHIPPING DATE	ARRIVAL DATE

SPECIAL INSTRUCTIONS

ROCW 00137

CB 300 REV 1

Monsanto

INV

DIV SALES

SHIPPER'S NO	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
412010		09-08-71	59-08604	09-08-71	SL 9-0863

CAR INITIALS AND NO

TERMS: NET 30 DAYS

PREPAID OR COLLECT - ROUTING: 09-08-71

DELIVERY F O B: PPD GULF DISTRIBUTOR TRUCK

ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	CUPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	1178	2-1-2		02-020-628087

SOLD TO:
ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIP TO:
SAME

0295-141-16-0-A-100087

DESCRIPTION	QUANTITY	PRICE & UNIT		AMOUNT
10 -54 GAL DRUMS -030 PYDRAUL 312 2-M-1-6760-312-11-0001-02-01 5000. *	540.	GL 2.55	U	1377.00
AL				

SHIPPING DATE	ARRIVAL DATE

ROCW 00138

CB 200 REV 7-70

16

Consanto

INV

DIV SALES

SHIPPER'S NO	DISTRICT	DATE ENTERED	CUSTOMER'S ORDER NO	INVOICE AND SHIPPING DATE	INVOICE NUMBER
412009		08-18-71	59 08454	08-18-71	SL 8-2512

TERMS: NET 30 DAYS — 08-18-71 — CAR INITIALS AND NO

PREPAID OR COLLECT – ROUTING: PPD GULF DISTRIBUTER TRUCK

DELIVERY F O B: ST LOUIS MO MIN FRT PPD

SHIPPED FROM	WHSE CODE	BOOKED THRU	COPIES CODE	CUST FORM	
RUSSELLVILLE KY	1860	XX-1178	2-1-2		02-020-028087

SOLD TO: ROCKWELL MANUFACTURING CO
RUSSELLVILLE KY 42276

SHIPPED TO: SAME

0295-141-16-0-A-10068762

DESCRIPTION	QUANTITY	PRICE & UNIT	AMOUNT
10 54 GALLON R DRUMS -030 PYDRAUL 312 2-M-1-0760-312-11-0001-02-01 5000. *	540. GL	2.55 U	1377.00

FM

SHIPPING DATE	ARRIVAL DATE

ROCH 00139

BCC Richard Davis - GO

September 1, 1960

Mr. Stephen B. Logan
Louisville Branch Engineer
American Mutual Liability Insurance Co.
120 Iroquois Manor Office Building
5330-A South Third Street
Louisville 14, Kentucky

Dear Mr. Logan:

Your letter requesting information on Pydraul A-200 has been forwarded to me for reply.

Animal toxicity studies with this fluid indicate that the lethal oral dose in rats is approximately 10,000 milligrams per kilogram of body weight. When applied to the skin of rabbits, the lethal dose was approximately 1,000 milligrams per kilogram. Our interpretation of this data is that accidental ingestion of the fluid is not a hazard in view of the high oral lethal dose. The lethal dose following skin penetration is such, however, that in the case of workmen, prolonged and repeated skin contact should be avoided. Such exposure must also be avoided to prevent skin irritation.

We also recommend that vapor inhalation be prevented when the fluid is at elevated temperatures. The prevention of such an exposure again relates to prolonged or repeated incidents rather than single massive or acute exposures. In the case of the latter, workmen would not voluntarily subject themselves to concentrations that are hazardous for short periods.

If there is a leak in an hydraulic system containing Pydraul A-200 such that the fluid may be sprayed on hot or molten metal surfaces, the fluid will obviously volatilize or decompose, depending on the temperatures of the metal. Animal toxicity studies with the decomposition products of the components of Pydraul A-200 again indicate that the acute hazard of inhalation of the decomposition products is not serious. The fluid decomposes to acidic and phenolic materials which form white clouds and are irritating to the respiratory tract and eyes to the extent that workmen will not tolerate seriously toxic concentrations.

DEFENDANT'S EXHIBIT 10 9-23-93 MB

ROC# 00028

I am not at liberty to divulge the composition of the fluid. As our label indicates, Pydraul A-200 does contain chlorinated hydrocarbons. There is no evidence, however, that in the decomposition of these chlorinated hydrocarbons, referred to above in the comments about system leaks, any significant concentrations of phosgene are evolved. I mention this point because of the history of phosgene production when some of the aliphatic chlorinated hydrocarbons have been used as fire extinguishers.

I believe your other questions relative to physical and chemical characteristics and properties are answered in the enclosed literature.

If you have any additional questions, please let me know.

Very truly yours,

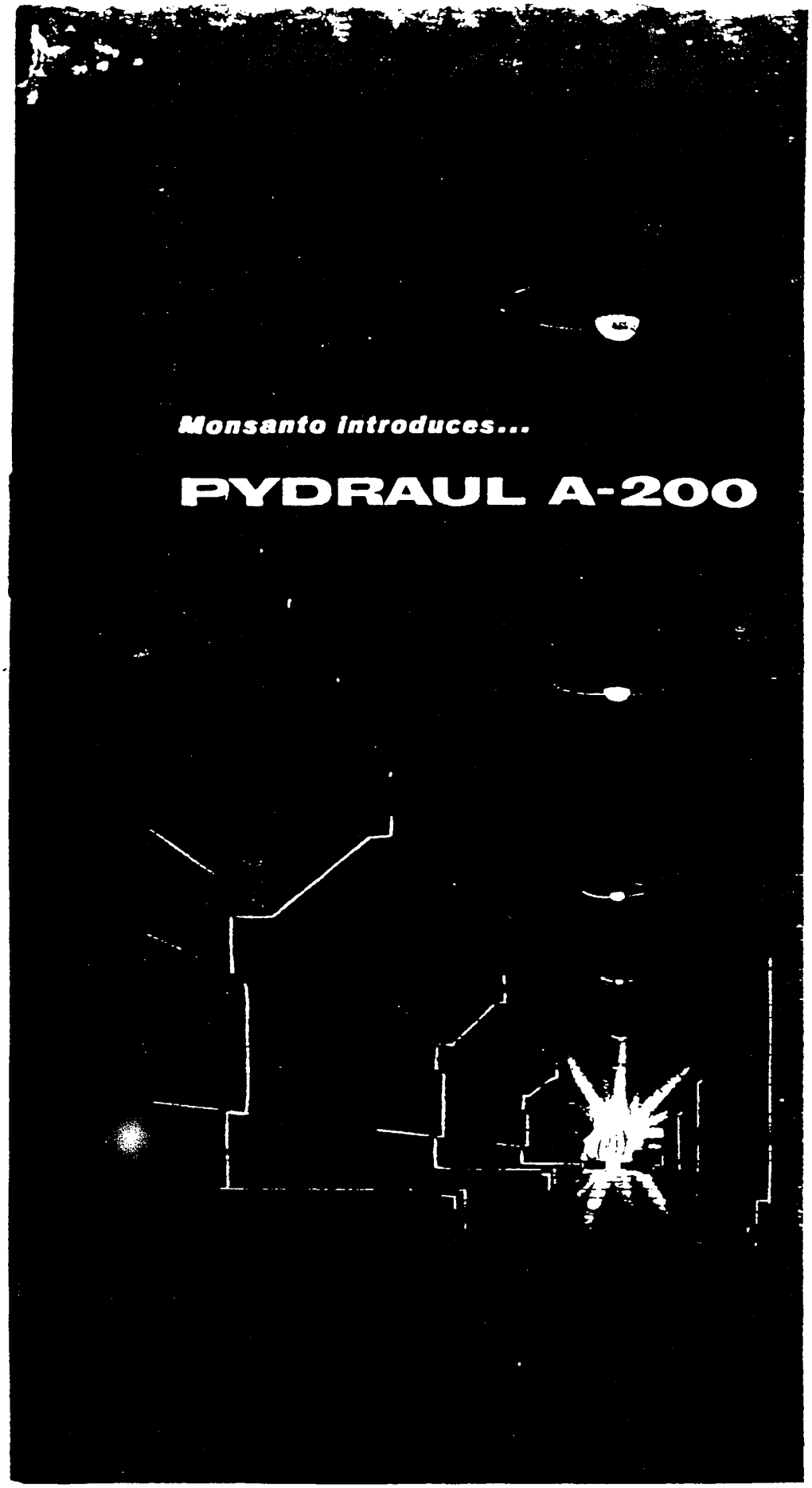
Elmer P. Wheeler
Assistant Director
Medical Department

EPW:dh
Enclosures 3

1) "Monsanto introduces ... Pydraul A-200"

2) "Monsanto Fluids for Specialized Engineering"

3) "Know Your Hydraulic Fire Hazards"



newest
lowest cost
all-synthetic
fire-resistant
hydraulic fluid

In 1951, Monsanto introduced the first synthetic fire-resistant hydraulic fluid for industry. Pydraul F-9 became the standard in its field, was listed with Underwriter's Laboratories. Today, it is the ONLY *fire-resistant fluid to have such listing.*

But Pydraul F-9 and the other brands of fluids that followed could deliver only a given "ceiling of performance" at a given price per gallon.

Now, Monsanto offers Pydraul A-200, a completely new synthetic fire-resistant hydraulic fluid. It performs like premium-grade petroleum oils, gives excellent resistance to fire, and is available at a savings of 40 cents on the gallon!

Pydraul A-200 takes the danger out of hydraulic fluid operations. Equipment can be run near ignition sources without worry of a sudden line burst ending in disaster. And the cost is low . . .

ROCW 00030

PYDRAUL A-200 IS SAFE...

In all important tests for fluid fire-resistance, Pydraul A-200 passes with flying colors. Here are the tests and the results:

HOT MANIFOLD TEST (per MIL-F-7100) (Pydraul A-200 was exposed to the surface of a manifold, 1300° F.)	**FLUID DID NOT FLASH OR IGNITE**
HIGH-PRESSURE IGNITION TEST (AMS-3150B) (Pydraul A-200 was sprayed through a small orifice at 1000 psi, passing through the flame of an oxy-acetylene torch, 6000° F.)	**FLUID DID NOT FLASH OR IGNITE**
LOW-PRESSURE SPRAY TEST (AMS-3150B) (Pydraul A-200 was 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 A-200 was exposed to the surface of a molten alloy, exceeding 1100° F.)	**FLUID DID NOT FLASH OR IGNITE**

A-200 IS ECONOMICAL...

The biggest economy of any fire-resistant hydraulic fluid is one which cannot be *seen*—until a hydraulic line breaks in the plant, and the fluid is sprayed to a nearby ignition source. When this happens, a flammable fluid can destroy equipment, lose thousands of dollars of production, injure personnel, and even cause loss of life!

Pydraul A-200 is a kind of "chemical insurance policy" . . . *your* protection against production loss and injury due to hydraulic fluid fire.

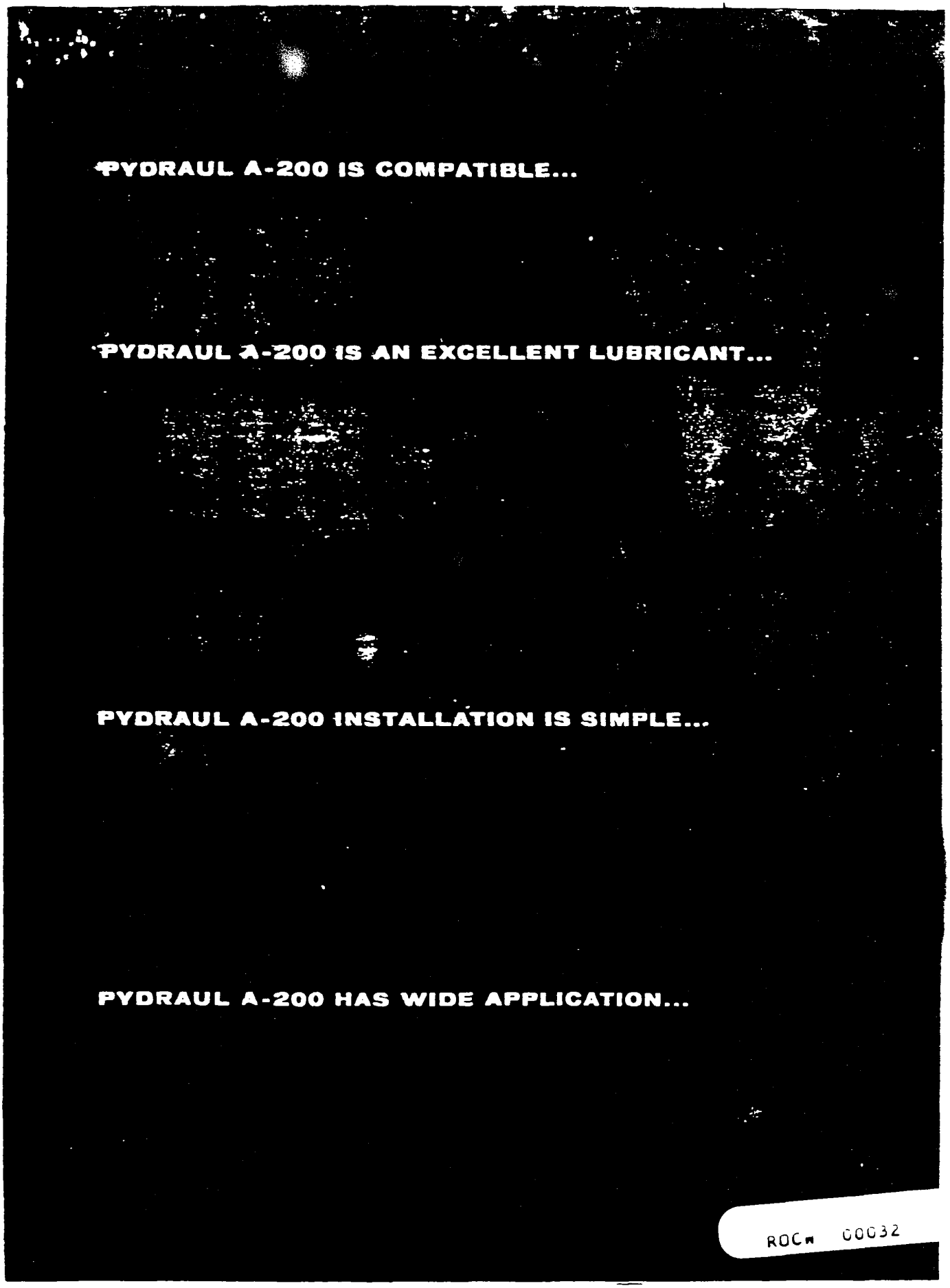
Pydraul A-200 is important to maintenance programs, also. "A-200" meets the important lubricating requirements found in premium petroleum oils—nothing has been sacrificed to achieve Pydraul A-200's excellent fire-resistance! High film strength and good anti-wear properties *protect* hydraulic equipment and costly components—and Pydraul A-200 is outstanding in film strength and anti-wear performance.

Low initial cost sets Pydraul A-200 in a class by itself in the field of all-synthetic fire-resistant fluids. Where safety counts, Pydraul A-200 is the *finest* hydraulic fluid available—at the lowest cost per gallon!

PYDRAUL A-200 IS RELIABLE...

Four reasons why "A-200" is the fluid you can count on:

NON-THICKENING	Pydraul A-200 is designed to be permanent. It does not have to be inspected or replaced from month to month, or year to year. "A-200" does not thicken with use, will not form sludge or lose desirable properties with time.
"RUGGEDNESS"	Pydraul A-200 has better resistance to abuse—temporary overheat, bearing overload, and other stresses—than any other fire-resistant fluid. It resists "breakdown," even under extreme conditions.
GOOD ANTI-RUST	A-200 protects metal surfaces in the presence of water. Passes rust test (ASTM-D-665-A) with perfect score—no rust (10.0)
SHEAR STABILITY	A-200 undergoes no loss of viscosity, even after many years of use in the most severe pump operations.

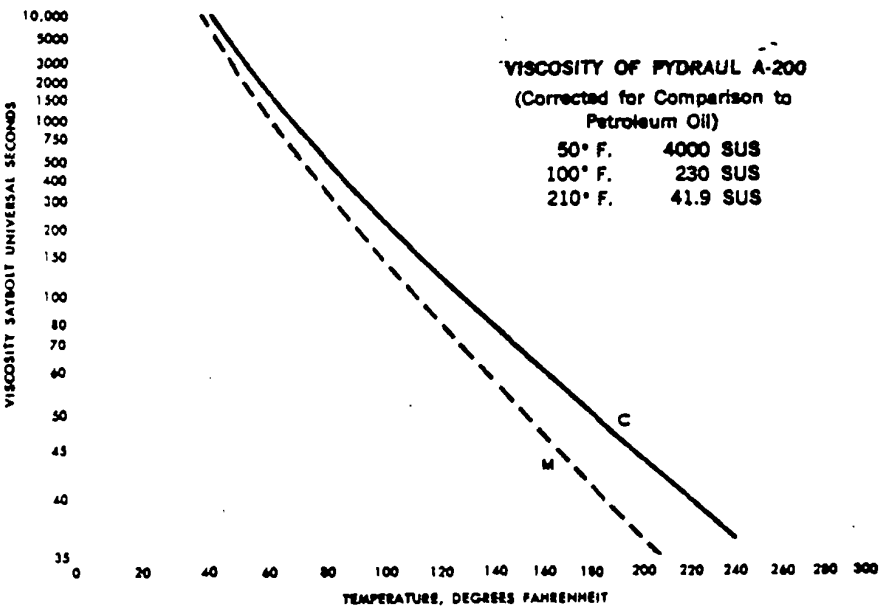


PYDRAUL* A-200 TYPICAL PROPERTIES

Viscosity:

Laboratory viscosity measurements are effected by fluid density. Because petroleum oils all have similar densities, their measured viscosities can be compared. The densities of synthetic fluids vary, however, so the measured viscosities must be corrected if comparisons are to be made.

In the graph below, curve "M" is the laboratory-measured viscosity of Pydraul A-200. Curve "C" shows the viscosity-temperature relationship of Pydraul A-200, modified for the differences in densities between oil and Pydraul A-200. Comparing curve "C" with a viscosity curve of a medium weight petroleum hydraulic oil, it is seen that the two are viscosity equivalents at normal operating temperatures.



VISCOSITY OF PYDRAUL A-200
(Corrected for Comparison to Petroleum Oil)

50° F.	4000 SUS
100° F.	230 SUS
210° F.	41.9 SUS

Density (Gms/cc)	1.42 @ 100° F. 1.43 @ 60° F.
Pour Point:	+ 5° F.
Auto-ignition Temperature:	Above 1200° F.

HANDLING AND STORAGE

Like all specialized hydraulic fluids, certain precautions are advisable when handling Pydraul A-200. No problems will arise when it is used as recommended.

Repeated or continuous skin contact should be avoided and inhalation of the vapors at elevated temperatures should be prevented. Pydraul A-200 is only mildly irritating to the eyes (but can cause pain) and like any other synthetic hydraulic fluid, it exerts a solvent-type action on the skin. Where prolonged contact cannot be avoided, gloves should be worn.

There is no vapor inhalation hazard associated with use at room temperature. In brief exposure to vapors given off at elevated temperatures, no systemic effects have been found in extensive animal experimentation. Exposures of one hour to the decomposition materials showed local respiratory irritation, but no systemic effects.

Eye irritation studies after using the material full strength showed it be a mild irritant with no permanent damage to the eye tissues.

If Pydraul A-200 is splashed or sprayed into the eyes, wash thoroughly, with water. To relieve irritation, physicians have used 1% pontocaine solution as well as the opthalmic cortisone acetate solution.

Pydraul A-200 can be stored at sub-zero temperatures without damage to the fluid. Just allow A-200 to warm to room temperature, and use

*REG. U. S. PAT. OFF.

2-732-0389-A0-63 LITHO IN U.S.A.

Monsanto

Fluids

For Specialized Engineering

In today's rapidly developing technology—engineering design in many fields requires special functional fluids that will solve a variety of problems. In applied hydraulics, aerodynamics, electronics, nucleonics, and mechanical engineering, special liquids are needed for critical tasks. Fluids must be found to dissipate heat or to convey heat; to transmit pressure or to neutralize pressure by lubrication; to slow neutrons without absorption; to withstand extreme cold; to resist vaporization and remain stable under high heat. For each application, varied combinations of properties are necessary.

The key to providing fluids "tailored" for the job is synthesis—the *chemical* building of basic compositions of matter designed for special *physical* properties. Monsanto has pioneered in the development of specialized functional fluids. For the past 10 years, Monsanto's half-century of experience in organic chemical synthesis has been called on again and again to provide liquids with special combinations of properties—for dielectric uses, coolants, specialized hydraulics, lubrication. Today, over twenty of these fluids are in commercial use—and many more are available.

ROC M 00034

Here is a summary of the general physical properties of 20 selected Monsanto functional fluids. These represent the *range* of products now available in commercial or semi-commercial quantities. In reviewing the table in the light of your own fluid, lubricant, or dielectric applications, may we call your attention to these facts:

- The products shown were developed for particular applications; their properties were carefully designed for that specific use. Often these properties can be modified through synthesis or formulation.
- Although developed for particular uses, in many cases the products have been found to be admirably suited to entirely different applications. For example: Fluid *OS-45 III* (Coolanol 45) designed for use as a high temperature hydraulic fluid, is also now being used extensively as an insulant-coolant in electronic equipment.
- In addition to the products listed in this table, a number of other commercial, development and research products are available. Among these are fluids designed for use as steam turbine lubricants; automobile automatic transmission fluids; high-temperature aircraft and missile fluids stable above 800°F.

Others are completely new chemical liquids with interesting physical properties in search of a use.

SUMMARY OF GENERAL PROPERTIES OF S

Present major uses / PROPERTIES / Product	FIRE-RESISTANT HYDRAULIC FLUIDS AND LUBRICANTS								HIGH-TEMPERATURE HYDRAULIC FLUIDS AND DIELECTRIC-COOLANTS			FIRE
	SKYDROL* 7000	SKYDROL 500	PYDRAUL* 60	PYDRAUL 150	PYDRAUL F-9	PYDRAUL 625	PYDRAUL AC	OS-81	COOLANOL 45 OS-45-III	OS-45-IV	OS-59	AROC 12
Viscosity, Centistokes @ 100°F.	15.5	11.5	11.1	30.8	47	135	88.2	35.25	12.2	12.0	6.8	4
@ 210°F.	3.85	3.92	2.65	8.0	5.5	6.1	5.15	3.18	3.95	3.95	2.2	<
Pour Point, °F.	−70°	<−85°	−70°	−55°	−5°	20°	20°	15°	<−85°	<−85°	<−85°	
Maximum Bulk Temperature, °F.	200°	225°	200°	200°	300°	300°	300°	300°	400°	550°	600°	6
Boiling Point @ 760 mm. Hg., °F.	709°	—	707°	617°	644°	724°	688°	>600°	>700°	>700°	>700°	5
Coefficient of Thermal Expansion, per °F. at use temp.	0.00042	0.00045	—	0.00042	0.00041	—	0.00040	—	0.00048	0.00048	0.00046	0.00
Specific Heat @ 25°C. or M. Pt., BTU/lb/°F.	0.42	0.38	0.42	0.40	0.32	—	—	0.31	0.45	0.45	0.45	0.
Thermal Conductivity, BTU/hr/ft²/ft/°F.	0.0477	0.0777	0.047	0.070	0.067	0.065	—	—	0.080	0.080	0.080	0.0
Bulk Modulus, psi	328,000	308,000	328,000	319,000	387,000	375,000	—	—	253,000	253,000	253,000	-
Specific Gravity @ 25°/25°C. or M. Pt.	1.08	1.07	1.09	1.13	1.28	1.36	1.35	1.40	0.89	0.89	0.88	1.
Resistivity, ohm — cm.	5.0×10^9	0.4×10^9	—	—	1.5×10^9	—	—	—	2×10^{10}	—	6.7×10^{11}	> 5
Dielectric Strength @ 60 cps, 0.1 in., 25°C.	—	—	—	—	33 KV	—	—	—	27 KV	—	44 KV	> 3
Dielectric Constant @ 1000 cps, 25°C.	8.87	—	—	—	6.25	—	—	—	2.69	—	2.47	4
Power Factor, per cent @ 1000 cps, 25°C.	0.49	—	—	—	2.2	—	—	—	1.6	—	0.03	<
Flash Point, °F., Cleveland Open Cup	425°	360°	435°	380°	430°	465°	420°	—	370°	370°	370°	2
Fire Point, °F., Cleveland Open Cup	475°	425°	460°	470°	675°	745°	650°	—	430°	430°	435°	3
Autogeneous Ignition Temperature, °F.	1050°	>1100°	>1000°	>1100°	>1100°	>1100°	1100°	>1100°	660°	700°	705°	> 1
Fire Resistant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Y
Radiation Resistant	No	No	No	No	No	No	No	No	No	No	No	N

*SKYDROL, PYDRAUL, OS-45, AROCLOR, SANTOWAX: MONSANTO TRADEMARKS, REGISTERED U. S. PATENT OFFICE.

THE INFORMATION ABOVE IS, TO THE BEST OF OUR KNOWLEDGE, ACCURATE AND RELIABLE. HOWEVER, SIN

FIELDS OF USE FOR FLUIDS

The following will describe the variety of fields for which Monsanto already is supplying specialized fluids:—

Aircraft Hydraulic Systems

SKYDROL* 7000 was the first fire-resistant hydraulic fluid developed for propeller aircraft that has been accepted by the C.A.A. SKYDROL 500 is now available for the higher-altitude, low-temperature operation of jets; it will be used in all the turbo-jet fleets now being built in America.

Dielectric-Coolants

Stable Coolant 45 is a broad temperature range, insulating coolant ideally suited for a variety of electronic cooling applications: magnetron subassemblies, klystrons, traveling wave tubes, amplifiers, power supplies, etc.

Missilery

Fluid OS-45 III is a high viscosity index fluid for reliable power transmission operation from −65° to 400°F in guided missiles and high-speed aircraft. Fluid OS-45 Type IV is a high-temperature fluid operable to 550°F.

Applied Hydraulics

PYDRAUL* F-9 is a fire-resistant hydraulic fluid for equipment such as die-casting machines, conveying equipment handling molten metals, and many other hydraulic operations near ignition sources. PYDRAUL 60 and PYDRAUL 150 are special viscosity fluids for precision regulating equipment.

Nuclear Reactor Mo

Monsanto's polyphenyls resistance to thermal an cation as coolant-moder

Lubrication

Monsanto supplies sev resistant lubricants suita tion. Among these . . . PY cant that curtails carboni flash fires and explosions cant that shows much pr

Fluid Drives

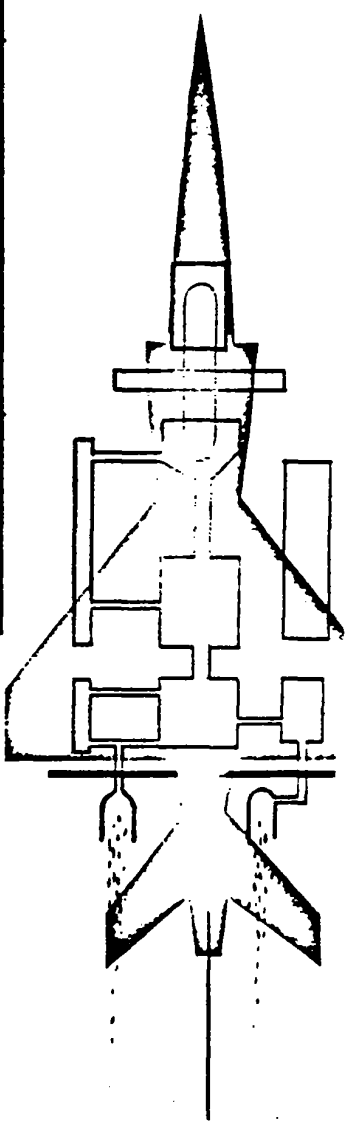
Monsanto supplies a nun

ROCW 00036

LECTED FUNCTIONAL FLUIDS

SISTANT DIELECTRICS, COOLANTS, HEAT TRANSFER FLUIDS				NUCLEAR REACTOR MODERATOR-COOLANTS			
AROCLOR 1232	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	BIPHENYL	SANTOWAX® R	SANTOWAX OM	ISOPROPYL-BIPHENYL
6.9	17.2	45.3	46.4	—	—	—	4.7
< 1.8	2.5	3.2	6.14	0.98	—.	2.05	1.40
— 32°	2°	20°	50°	156°	413°	150°	— 65°
600°	600°	600°	600°	> 750°	> 750°	> 750°	>700°
554°	617°	644°	689°	491°	687°	662°	570°
0.00073	0.00068	0.00070	0.00066	0.00050	0.00052	0.00052	0.00096
0.31	0.29	0.27	0.26	0.40	0.50	0.42	0.42
0.063	0.058	0.057	0.054	0.076	0.063	0.065	0.07
—	—	428,000	—	—	—	—	—
1.23	1.38	1.45	1.54	0.984	0.955	1.06	0.979
$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 1 \times 10^{12}$	$> 1 \times 10^{13}$	$> 1 \times 10^{12}$	$> 1 \times 10^{13}$
> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 40 KV
5.4	5.8	5.6	5.0	2.5	2.58	2.6	2.66
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.07
308°	350°	382°	> 690°	235°	375°	340°	282°
460°	> 610°	> 640°	> 690°	255°	460°	390°	306°
> 1100°	> 1200°	> 1200°	> 1200°	> 1000°	> 1000°	> 1000°	845°
Yes	Yes	Yes	Yes	No	No	No	No
No	No	No	No	Yes	Yes	Yes	Yes

CONDITIONS OF USE ARE BEYOND OUR CONTROL, MONSANTO CHEMICAL COMPANY DISCLAIMS ANY LIABILITY ARISING FROM THE USE OF THE DATA.



ion, Cooling

kyl derivatives have extreme
iation damage . . . for appli-
in severe environments.

types of specialized fire-
or high temperature opera-
'L AC, air compressor lubri-
and deposits responsible for
d OS-81, new turbine lubri-
in use.

of specialized fluids suitable for the specialized needs of power transmission and fluid drives.

Heat Transfer

AROCLOR® heat transfer fluids are chemically stable and fire-resistant heating media which permit non-pressurized heating systems to deliver 600°F. processing heat.

Transformers, Capacitors

For 25 years Monsanto has supplied the dielectrics for transformers and capacitors ranging in size and application from house-sized utility transformers to thumb-sized capacitors in high-fi sets.

ROCW 00037

Monsanto

FUNCTIONAL FLUIDS

TECHNOLOGY OF FLUIDS

Fluids for specialized engineering uses usually must be chemically synthesized. From knowledge of the desired end properties—candidate compositions-of-matter are examined that chemically and physically meet the general requirements. Rarely will a "pure" compound match highly stringent specifications. The proper "pure" compound, however, that closely approximates the needs is selected as the "base" stock; it is then modified with additives that further modify its viscosity index, its lubricity, pourpoint, or other properties.

Monsanto has available the facilities for making the widest variety of "base" stocks and additive modifiers of any chemical manufacturer. The Monsanto base stocks include the phosphate esters, many of which are unique to Monsanto, diphenyl and terphenyl and chlorinated derivatives, silicate esters and others. Available additives include corrosion inhibitors, viscosity index improvers, flow temperature depressants, and many other polyfunctional modifiers.

AUTOMATION	LUBRICATION	ELECTRONICS
RADAR	INSULATION	GUIDANCE
TRACKING	MECHANICS	PREHEATING
ATOMICS	AERODYNAMICS	POWER GENERATION
HEATING	LAUNCHING	POWER TRANSMISSION
KINETICS	LIFTING	HEAT EXCHANGE
BALLISTICS	PRESSURIZING	POWER STORAGE
COOLING		

WHEN NO EXISTING FLUID WILL DO THE JOB YOU NEED...

....Monsanto will work with you to create a fluid that does exactly what you want.

Write or Call...

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Lindbergh and Five Star Roads
St. Louis 24, Missouri

ROCH 00038

AN OUNCE of prevention can be worth the cost of a plant or even the life of a worker. You can isolate operations that could be hazardous; you can build fire walls, so that fire could be confined to certain areas, and you can install sprinkler systems.

But the simplest and surest way to protect against hydraulic fluid fires is to stop them before they start—with fire-resistant Pydraul* synthetic fluids. Pydraul fluids do not support combustion.

When emergencies occur, Pydraul eliminates the danger of local fires that can damage equipment or injure workmen . . . spread fire to other locations . . . flash flame to the reservoir of a flammable fluid . . . damage or destroy equipment before the sprinkler systems activate. By their very chemical nature, Pydraul fluids are fire-resistant—from start-up through every hour of operation.

*Pydraul: Monsanto trademark, Reg. U.S. Pat. Off.

ROCH C0040

PYDRAUL *is working for others...*

"Two weeks after we switched to Pydraul, an electrical control circuit of a cold chamber aluminum die casting machine failed, unknown to the operator. The operator continued to run the machine until the nitrogen in the accumulator unloaded into the oil reservoir and blew Pydraul twenty feet into the air—all over the machine, operator, helper and even directly into an open pot of molten aluminum.

"Instead of a flash fire and serious burns to several workmen, as well as general chaos in the shop, we suffered to the extent of two Pydraul-soaked workers and the loss of 40 gallons of Pydraul."

—Letter from the president of a Los Angeles die casting plant

"On Monday, October 25th, a hydraulic line hose at 1000 psi on a Cast Master die casting machine caught between two halves of the die and ruptured. Pydraul from the line splashed on the operator, into the aluminum melting furnace, and onto walls and ceilings 30 feet away.

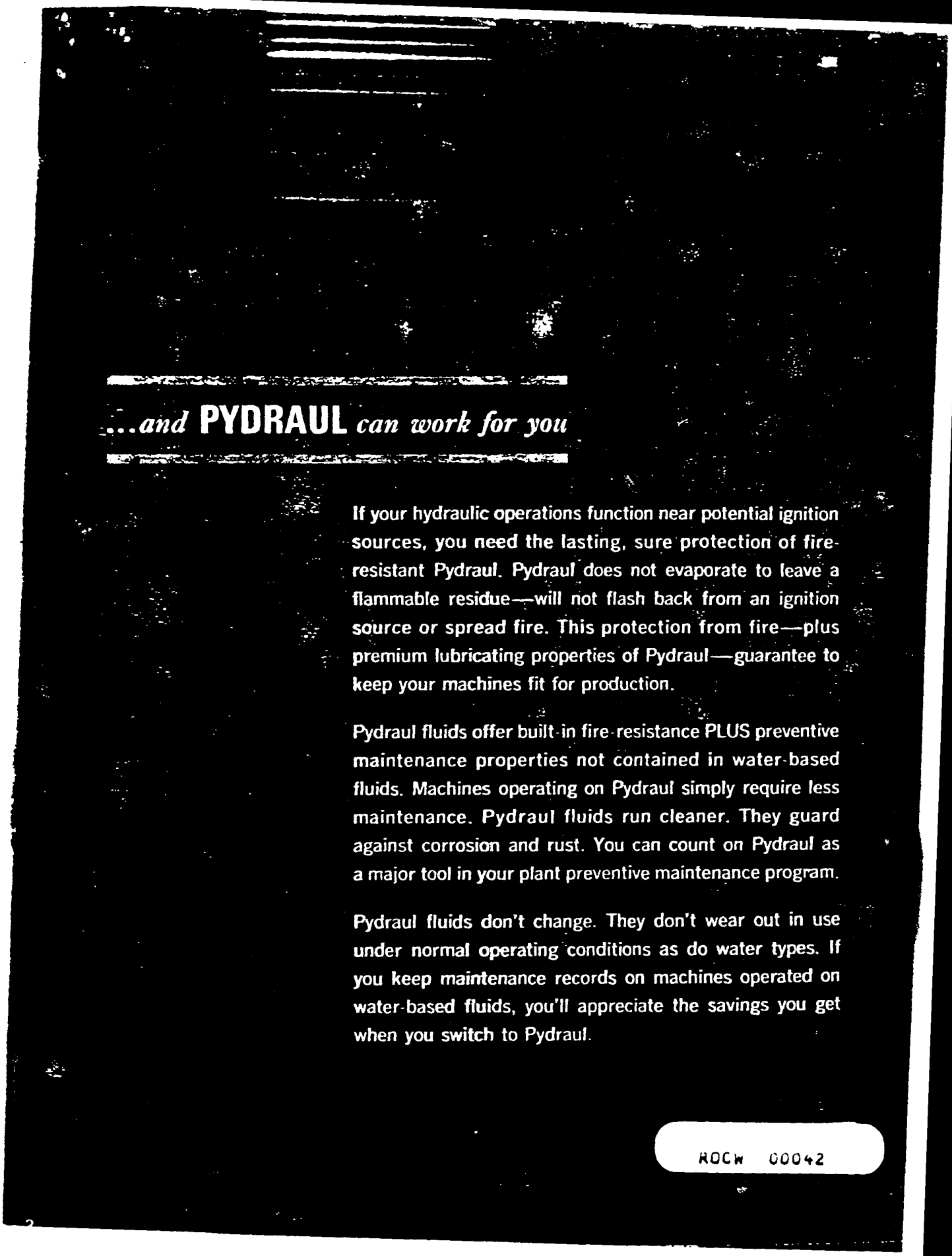
"Had flammable oil been used it would surely have ignited in the molten aluminum. The fire could have spread to the oil-covered operator, as happened in another plant previously. The danger of fire would have been still worse because of the presence of oil vapor in suspension in the air after it erupted from the oil line.

"The accident has proved to us conclusively the safety value of Pydraul."

—Letter from the superintendent of a Canadian die casting operation

"At our plant a Lake Erie die casting machine threw a vertical main piston rod through the roof and resulted in a great volume of Pydraul being sprayed on two workmen, the surrounding area, and into a pot of molten alloy above 800°F. There was no flash back from the metal pot, which would have set fire to the entire area and would have meant instant death to the two operators. Instead of this disaster, our production was back to normal within an hour."

—Personal statement of plant engineer



...and PYDRAUL *can work for you*

If your hydraulic operations function near potential ignition sources, you need the lasting, sure protection of fire-resistant Pydraul. Pydraul does not evaporate to leave a flammable residue—will not flash back from an ignition source or spread fire. This protection from fire—plus premium lubricating properties of Pydraul—guarantee to keep your machines fit for production.

Pydraul fluids offer built-in fire-resistance PLUS preventive maintenance properties not contained in water-based fluids. Machines operating on Pydraul simply require less maintenance. Pydraul fluids run cleaner. They guard against corrosion and rust. You can count on Pydraul as a major tool in your plant preventive maintenance program.

Pydraul fluids don't change. They don't wear out in use under normal operating conditions as do water types. If you keep maintenance records on machines operated on water-based fluids, you'll appreciate the savings you get when you switch to Pydraul.

ROCW 00042

PYDRAUL *fluids give you "double action" fire-resistance*

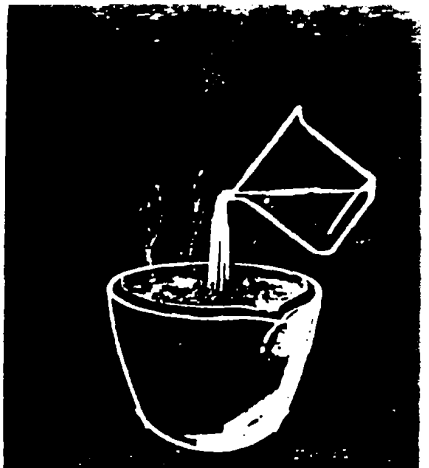
ACTION ONE *chemically built (active) fire-resistance*

Pydraul fluids are chemically synthesized from materials which resist burning. Water-based hydraulic fluids depend on the water for fire-resistance; the lubricant components are flammable. Glycol (in water-glycol fluids) and light petroleum oil (in water-oil emulsions) -- both will burn!

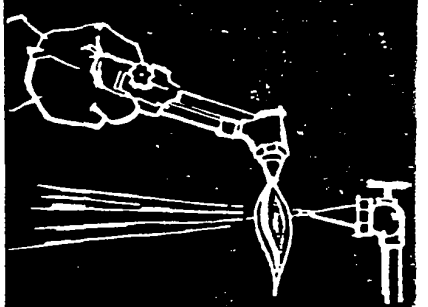
Compared with fresh water-based fluids for fire-resistance, Pydraul fluids seldom appear more fire-resistant; but, tests of *used* water-based fluids do not show the same degree of fire-resistance—because flammability increases as the water snuffer evaporates from the system.

The tests described below show you some of the rigorous methods of determining fire-resistance. The medium and high viscosity fluids—Pydraul F-9, Pydraul A-200, Pydraul 625 and Pydraul AC —do not flash or burn in any of these tests. The lower viscosity fluids—Pydraul 150 and Pydraul 60 may show intermittent flashing under severe exposure, but they will not support combustion away from an ignition source.

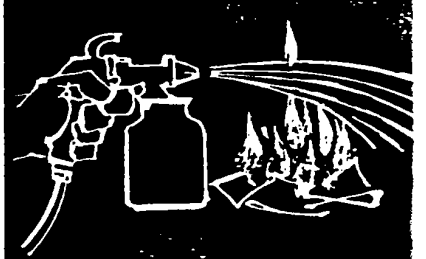
Pydraul F-9 is the only fire-resistant hydraulic fluid ever to receive listing by Underwriters' Laboratories, Inc.



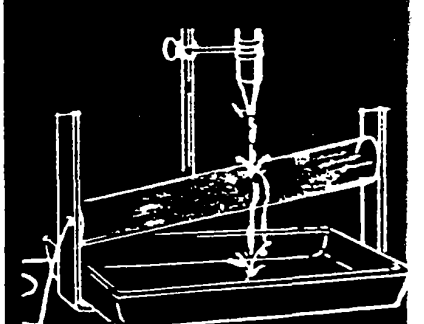
MOLTEN METAL IGNITION TEST —Fluid poured on molten metal.



HIGH-PRESSURE IGNITION TEST (AMS-3150B & MIL-F-7100)—Fluid sprayed at 1000 psi through flame from oxyacetylene torch, 6000°F.



LOW-PRESSURE SPRAY TEST (AMS-3150B)—Fluid sprayed at low pressure over an ignited oil-soaked rag.



HOT MANIFOLD TEST (MIL-F-7100)—Fluid dripped over surface of manifold at 1300°F.

ROCH 00043

ACTION TWO *lasting (passive) fire-resistance*

Pydraul fluids do **not change** in use—do not lose fire resistance as do water types. Pydraul fluids are homogeneous. They do not separate into two fluid layers under high use temperatures or low storage temperatures.

No simple methods have been devised for testing residual fire-resistance, but you can easily perform this demonstration:

DEMONSTRATION METHOD

1. Dip blotter paper squares in Pydraul, water-glycol and plain water.
2. Drain off excess fluid and prop on glass dish for an hour or two.
3. Ignite with a paper book match.
4. You'll see for yourself! Pydraul does not evaporate, does not burn.
5. Piece dipped in water burns normally.
6. Water-Glycol paper burns brighter, hotter, due to the flammable glycol residue.

This demonstration points out a second type of fire-resistance that Pydraul fluids have and water types do not—*lasting* fire-resistance that protects your plant, equipment, and personnel against fire—in spite of exposure to air through breaks, leaks, or air entrained during maintenance.

In any hydraulic operation, a break can spew fluid over equipment, floors, walls, and ceilings . . . or a leak can produce an "innocent" puddle.* But Pydraul fluids *remain* fire-resistant.

**Industrial fires have occurred under just these circumstances. In one incident, a machine was drained, leaving a puddle of water-glycol fluid on the floor. A welder came in to repair a piece of equipment and a spark from his torch fell into the puddle. The puddle ignited and the resulting fire damaged equipment and destroyed the control circuit panel of the machine.*

RGCw CCC44

OR 21

HYDRAULIC FLUID SURVEY

PLANT OR WORKS

DEPARTMENT

SURVEY MADE BY | APPROVED BY

DATE SURVEY STARTED | DATE SURVEY COMPLETED

MINIMUM
SLIGHT
MEDIUM
EXTREME

1	2	3	4	5	6	7	8	9	10	11
ITEM NO	MACHINE USING HYDRAULIC UNIT SI	FLUID NOW USED	DISTANCE TO IGNITION SOURCE. FEET	IDENTITY OF IGNITION SOURCE	SYSTEM CAPACITY (GALS.)	NORMAL SYSTEM OPERATING PRESSURE PSI	MAXIMUM DISCHARGE RATING OF PUMP GPM	PUMP MFR AND MODEL	CONTROL VALVE SI MFR AND TYPE	FIRE HAZAR RATI

ROCW 00045

RE HAZARD RATING SCALE

stem not using a petroleum oil as a fluid, but using one of the materials tested and rated "satisfactory" or "acceptable" as a -resistant" fluid by Underwriters' Laboratories or Factory Mutual Laboratories, or other qualified agency.

stem using petroleum oil as the fluid but with no sustained or customarily operated sources of ignition located in the same vicinity.

stem using petroleum oil as the fluid, with surfaces or metal or equipment in that area heated above the flash point of the oil below 600 F., and adequately protected with fire control apparatus.

stem using petroleum oil, not protected by automatic fire extinguishing systems, and having sustained sources of ignition within rea that could be reached by a spraying or leakage of oil from the supply or from the return lines. The presence of oil or gas s in that same vicinity would intensify the hazard even further.

12 PLAN OF ACTION FOR REDUCING DEGREE OF HAZARD	13 EXPECTED COMPLETION DATE	14 REMARKS

For additional forms, contact Monsanto.

ROC# 00046

You need the safety protection of fire-resistant PYDRAUL hydraulic fluids if these ignition sources are within "spraying distance" of your hydraulic operation:

Open Flame—gas burners, etc.
Molten Metal
Red Hot Metal—ingots, etc.
Welding Equipment
Heat Treating Furnaces—open ovens
Heated Dies
Open Field Rheostats—switching arm

Pydraul fluids give you DOUBLE ACTION protection—no fire . . . no spread of fire to other areas . . . no flash back to reservoir . . . no flammable residue left on floors, walls, ceilings.

rate your own FIRE SAFETY...

Use the survey sheet inside this page to list each hydraulic machine or operation and potential source of ignition. A fire hazard indicated on your survey sheet identifies a clear need to convert your machines to a Pydraul for DOUBLE ACTION fire protection.

PYDRAUL synthetic fluids are now used in these applications; but, the danger of hydraulic fires exists in many other applications if ignition sources are near.

Die Casting Machines
Hydraulic Presses
Furnace Tilters
Regulators
Permanent Mold Casters
Stampers
Extrusion Presses
Scarfers
Ingot Loaders
Plating Machines
Scrap Metal Balers
Electric Furnaces
Injection Molding Machines
Forging Presses
Furnace Door Openers
Elevators and Hoists
Hydraulic Jigs

ROCW 00047

DISTRICT SALES OFFICES

ATLANTA	3390 Peachtree Road, N.E., 30326	(404) 231-4320
BOSTON	Everett Station, 02149	(617) DU7-5010
CHICAGO	3158 Des Plaines Avenue, 60018	(312) 296-6688
CINCINNATI	2330 Victory Parkway, 45206	(513) 751-6707
CLEVELAND	3645 Warrensville Center Rd., 44122	(216) 991-5400
DETROIT	500 Northland Towers, 48235	(313) 357-0910
HOUSTON	1300 Main Street, 77002	(713) CA3-4011
LOS ANGELES	6670 East Flotilla Street, 90022	(213) RA3-2492
MINNEAPOLIS	912 Northstar Center, 55402	(612) 339-4651
NEW YORK	277 Park Avenue, 10017	(212) 922-4111
PITTSBURGH	4 Gateway Center, 15222	(412) 261-2156
ST. LOUIS	800 North Lindbergh Blvd., 63166	(314) WY3-1000
SAN FRANCISCO	2710 Lafayette Street, Santa Clara, Calif., 95052	(408) 243-0414
SEATTLE	911 Western Avenue, 98104	(206) 622-4203
SPRINGFIELD	812 Monsanto Ave., Springfield, Mass., 01102	(413) 788-6911
WILMINGTON	2005 Concord Pike, 19803	(302) OL8-6531

16 mm full-color movie available—15 minutes

"BEFORE HYDRAULIC FIRES START"

Now you can see for yourself—and demonstrate to others

tests showing fire-resistance of Pydraul fluids

typical Pydraul installations

An incident in which Pydraul prevented disaster

To receive a copy for showing, write:

Monsanto Company • 800 North Lindbergh • St. Louis, Missouri 63166

ROCH 00048