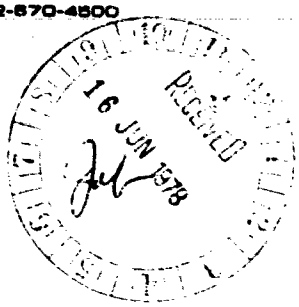
88-780000184

8EHQ-0678-0184

VELSICOL CHEMICAL CORPORATION

341 EAST OHIO STREET • CHICAGO, ILLINOIS 60611 • 312-670-4500

June 13, 1978



88-780000184

Ms. Joan Urquhart
Document Control Officer
Chemical Information Division
OTS (WH-557)
U.S. EPA
401 M Street S. W.
Washington, D.C. 20460

Re: Firemaster 680, trade name for Benzene, 1,1'-(1,2-Ethanediylbis(oxy) Bis (2,4,6 Tribromo-, CAS #37853-59-1

Dear Ms. Urquhart:

The attached documents are submitted for your files and in compliance with TSCA section 8(e) if the latter is necessary.

The Calo memo summarizes status of a toxicology study. The Davis memo reports results of possible industrial exposure. The other documents report on laboratory toxicology and biodegradability studies.

For the record, the documents are identified as follows:

A) Memo From C. J. Calo To Thomas Loy, Re: Trip to IRDC Laboratories in Mattawan, Michigan, April 4 & 5, 1978.

B) Memo From H. W. Davis for the file, Re: Telephone inquiry regarding possible adverse effects due to Firemaster 680, June 1, 1978.

C) "Acute Inhalation Toxicity Study in Rats" IRDC #163-502, January 3, 1978.

D) "28 Day Rat Feeding Study", WARF Institute #2071960, December 22, 1972.

E) Chemical Biotesting Center, Chemicals Inspection & Testing Institute, Japan "Method for Testing the Degree of Accumulation of Chemical Substances in Fish Body".

F) "Acute Toxicity Studies in Rabbits and Rats: IRDC #163-502, December 22, 1977.

2

0 0 0 2

PAGE 0011

G) "Acute Dermal LD 50 (1 level)" WARF #3042861 April 26, 1973.

H) "Acute Oral Toxicity Study in the Albino Rat" IRDC #134-011, November 27, 1978.

I) "Acute Oral Toxicity Study in Beagle Dogs" IRDC #134-012, November 27, 1974.

J) "Acute Inhalation Toxicity in the Albino Rat" IRDC #134-013, November 27, 1974.

K) "Acute Toxicity (TL_{50}) Study in the Bluegill" IRDC #134-014, December 13, 1974.

L) "Acute Toxicity (TL_{50}) Study in the Rainbow Trout" IRDC #134-014, December 13, 1974.

M) "Modified Draize Multiple Insult Test in Male Humans" IRDC #134-017, January 30, 1975.

N) "Twenty-Eight Day Dermal Toxicity Study in Rabbits" IRDC #134-015, February 11, 1975.

O) "Twenty-one Day Inhalation Toxicity Study in Rats" IRDC #134-016, February 11, 1975.

P) "Acute Inhalation Toxicity in the Albino Rat After Pyrolysis" IRDC #134-038, March 12, 1975.

Q) "Acute Inhalation Toxicity in the Albino Rat After Pyrolysis" IRDC #134-039, March 12, 1975.

R) "Fourteen Day Range Finding Study in Rats" IRDC #134-053, April 10, 1975.

S) "Twenty Eight Day Toxicity Study in Rats" IRDC #134-018, May 19, 1975.

T) "Biodegradation Study With ^{14}C-Tagged MC-680" IBT No. 632-07189, November 20, 1975.

U) "Mutagenicity Evaluation FM680 Of 859-74-5" Final Report, LBI Project No. 2547, May 25 1976.

V) "Acute oral LD 50, Acute dermal LD 50 Skin Irritation, Eye Irritation" WARF #2081295, August 11, 1972.

VELSICOL CHEMICAL CORPORATION

w) "Biodegradability Study With ^{14}C-Tagged MC-680" IBT No. 632-07189, June 11, 1976.

X) "Primary Skin Irritation Test With Mother Liquor 680 Process, Code No. 7-29-76-B In Albino Rabbits" IBT No. 8530-09618, October 25, 1976.

Y) "Acute Heated Vapor Inhalation Toxicity Study with Granulated FM 680 containing Television rings manufactured by Xolox Corporation in Rats" IBT No. 8562-09787, December 6, 1976.

Z) "Skin Sensitization Test With Mother Liquor 680 Process in Albino Guinea Pigs" P.O. # 24 678-A, IBT No. 8530-09618, December 8, 1976.

Aa) "90-Day Subacute Oral Toxicity Study With Firemaster 680 in Albino Rats," P.O. No 21 981-A, IBT No. 8532-08925, January 6, 1977.

Bb) "90-Day Subacute Oral Toxicity Study With Firemaster 680 In Albino Rats, P.O. No. 21982-A, IBT No. 8532-08925, March 10, 1977.

We make no judgement as to whether these documents contain Information concerning a significant hazard. We reserve our right to contest the propriety of TSCA section 8(e).

Velsicol has not yet completely developed internal procedures for compiling all the information required at FR43: 11113, section IX. When those procedures are developed we plan to submit them to EPA for comment. In the meantime, if you desire further information on the subject covered by this report, please contact me at 312 - 670-4764.

Sincerely,

VELSICOL CHEMICAL CORPORATION

Thomas R. Loy

Thomas R. Loy
Manager
Regulatory Activities

TRL:br
Encl.

8EHQ 0012

4

90.00 - 130A 88-7800184 8EHQ-0678 - 0184 (A)

INTER-OFFICE CORRESPONDENCE

VELSICOL CHEMICAL CORPORATION

DATE	April 19, 1978		COPIES TO	MAIL NO.
TO	T. R. Loy	MAIL NO. 3322	D. M. Whitacre	3322
			J. A. Stewart	3322
			MSR/CJC/Files	
FROM	C. J. Calo	MAIL NO. 3322		
SUBJECT	Trip to IRDC Laboratories in Mattawan, Michigan, April 4 and 5, 1978			

PAGE 0005

M. S. Root visited the subject laboratory on the above indicated dates for the express purpose of reviewing toxicity data on numerous studies presently being conducted by that laboratory. The following is a review of the findings of her visit.

FM 680

IRDC #: 163-547

A teratology study in rats was performed with FM 680 at dosage levels of 0, 100, 1,000, and 10,000 mg/kg/day. The study is completed and the examination of the skeletal and soft tissue for anomalies is now in progress. All of the parameters investigated in the treated animals appear to be similar to control animals except in the two higher levels of 1,000 and 10,000 where there is a slight increase in the number of post-implantation losses. No gross anomalies were observed in the fetuses taken by cesarean section. Observations made from the 7th to the 15th day included cloudyness in one or both eyes of 3 females receiving the highest dose.

%: statistics?

Hexachlorocyclopentadiene

IRDC #: 163-573

A teratology study in rats was performed with hexachlorocyclopentadiene at dosage levels of 0, 3, 10, and 30 mg/kg/day. Maternal observations made upon animals receiving Hex included poor grooming in only a few animals at each of the dosage levels including the controls. In the experimental animals, all of the parameters investigated were similar to the controls, i.e., the number of gravid rats, number of dams with live fetuses, number of live fetuses per dam, number of post-implantation losses, number of implantations/dam, number of corpora lutea/dam and mean fetal body weight. Gross anomalies observed among those fetuses taken by cesarean section included the following: controls-one animal had a short tail and was also underweight; 3 mg/kg/day dosage level-4/15 animals from one litter had a bent tail and/or a short upper jaw and/or a protruding tongue and/or an open eyelid and/or tarsal flexure. Examination for soft tissue and skeletal animalies has not yet been completed.

5

0005

Quantitation?

Chlorendic Anhydride

IRDC #: 163-535

A teratology study in rats has been performed with Chlorendic Anhydride at the dosage levels of 0, 25, 100 and 400 mg/kg/day. There was a dose dependent relationship in the number of post-implantation losses at all Chlorendic Anhydride treatment levels. All other parameters were similar to the control animals. Maternal observations revealed that one animal at 100 mg/kg/day displayed a cloudy cornea from the 7th through the 20th day of gestation. Gross anomalies found in fetuses taken by cesarean section included, at the high dosage level of 400 mg/kg/day, a cleft lip and palate associated with the cleft lip in one of 12 animals of 1 litter. The average weight of the fetuses in this litter is 4 grams. Examination of fetuses for soft tissue and skeletal anomalies has not yet been completed.

hard data would be useful.

MC 984

IRDC #: 163-504

present graphically

Male rats at the highest dietary level (2500 ppm) of MC 984 in a 90-day subacute oral toxicity study displayed a difference of 14% in total weight gain when compared with control animals. There is a dose dependent decrease in weight gain among the male rats receiving 500 and 1,000 ppm of MC 984. Female rats receiving MC 984 exhibited a decreased weight gain of less than 10% when compared with the control female animals during the 12th week of study. Male rats receiving the highest dietary level and female rats receiving the 2 highest dietary levels displayed decreased food consumption of approximately 8%.

Ophthalmoscopic examination made during the final week of the study concluded that all animals were normal except for one male rat at 1,000 ppm which displayed blepharitis and conjunctivitis and one female rat at 2,500 ppm which displayed localized chorioretinal degeneration and a second female rat which also displayed blepharitis. General observations included hair loss, swollen hind limbs, and in 2 female animals at the 10,000 ppm dietary level, dilated pupils with no response to light.

cataracts? retinal degn? Optic nerve atrophy?

A general finding at necropsy was hydronephrosis which occurred in a few male and female rats at all dietary levels except the female controls. A few scattered foci in the lungs of some animals at all dietary levels was also reported. Hematology, clinical blood chemistry and urinalysis were performed on the these animals at monthly intervals. After the first month on study alkaline phosphatase activity of all male animals appeared to be slightly elevated. Urinalysis performed during the second month revealed occult blood in some animals from each dietary level including the controls. By the third month, these analyses appeared to be normal and compared favorably with the control animals.

Quantitative

how much?

did the nephrosis vanish?

MC 948

IRDC #: 163-527

What happened to the myelin

A delayed neurotoxicity study was performed in hens with MC 948 at the dosage level of 50,000 mg/kg given in two doses of 25,000 mg/kg each in distilled water as a suspension to 5 hens. Hens were observed hourly for the first 4 hours and daily for 28 days thereafter. Weekly weights [illegible] 7, 14, 21 and 28 revealed a slight weight loss among most

The above information is being fowarded to you for submission to the appropriate regualtory files.

PAGE 0001

Charles J. Calo

CJC/jh

margin comments by
Joseph Scipter
July 5, 1978

OFFICE CORRESPONDENCE

VELSICOL CHEMICAL CORPORATION

June 1, 1978		T. R. Loy	3322
FILE	MAIL NO.	N. R. Mitchell	4630
		H. A. Washer	5700
		F. A. Daniher	0714
FROM H. V. Davis	MAIL NO. 5460		

SUBJECT: TELEPHONE INQUIRY REGARDING POSSIBLE ADVERSE EFFECTS DUE TO FIREMASTER 680

-0184 (B)

PAGE 0020

Bruce Horvath, industrial hygienist with Borg Warner, called on May 31, 1978 regarding respiratory problems occurring in employees exposed to ABS polymers containing FireMaster 680.

Employees at their plant in the Netherlands and a customer(s) using these materials have been reported to be suffering from respiratory ailments, nausea and vomiting.

Mr. Horvath will follow up with a written report.

needed urgently

1) conditions of exposure
2) duration " "
3) concentration in exposure area
4) Physicians' complete report

HVD

Harvey V. Davis

lm

Joseph Deister July 5, 1978

REGULATORY DIVISION

JUN - 5 1978

RECEIVED

8

88-7800184

8EHQ-0678-0184 (6)

International Research and Development Corporation

SPONSOR: Velsicol Chemical Corporation

COMPOUND. CN-110-109

SUBJECT: Acute Inhalation Toxicity Study in Rats.

PAGE 0038

merging comments
July 5, 1978
Joseph Singer.

Basil K. J. Leong

Basil K. J. Leong, Ph.D.
Director of Inhalation Toxicology

Approved by: D. Clifford Jessup, Ph.D.
Associate Director of Research

[redacted]

Date: January 3, 1978

Declassified
8-22-78

163-502

3

0 0 0 4

I. SYNOPSIS

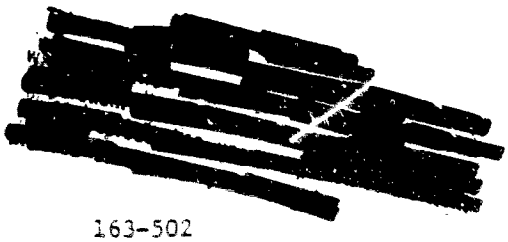
Inhalation exposure of rats for 1 hour to an atmosphere of CN-110-109 at a nominal concentration of 2.29 mg/l did not result in any observable toxic effects.

Based upon the experimental results, it is concluded that a single 1 hour inhalation exposure to the volatile components of CN-110-109 would not likely be harmful.

In accordance with the requirement of the DOT, Hazardous Materials Regulation, 49 CFR Part 173.343, CN-110-109 would not be classified as a Class B Poison by inhalation.

PAGE 0039

Did the compound remain as a uniform mist or did it settle out on walls of vessel and on fur? How much entered the airway?



163-502

II. COMPOUND

The compound was received from the Velsicol Chemical Corporation, Chicago, Illinois on July 12, 1977.

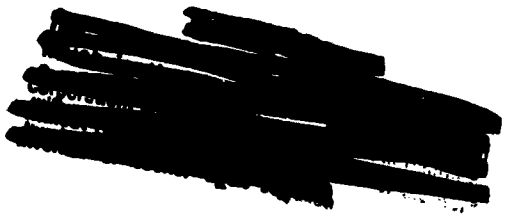
It was received and identified as follows:

Compound Identification	Description
CN-110-109	brown sand like granules

How pure?

PAGE 0040

[redacted]



III. PROCEDURE

A. ANIMAL EXPOSURE:

Five male and 5 female Charles River CD rats, weighing from 208 to 242 grams, were used in the study of the compound. The rats were housed individually in wire-mesh cages and were kept in temperature and humidity controlled quarters throughout the pre- and postexposure periods. Purina Laboratory Chow and water were supplied ad libitum except when the rats were in the exposure chamber.

PAGE 004

During exposure, the rats were caged in groups of 2 or 3 by sex in wire-mesh exposure cages. The cages were placed in a 160-liter cubical stainless steel-glass chamber. A constant chamber airflow was maintained by means of a rotary centrifugal air pump located at the exhaust side of the chamber. The chamber exhaust was filtered with an activated charcoal filter and a Cambridge Absolute® filter before being discharged outside of the laboratory.

B. VAPOR ATMOSPHERE:

The volatile components of the compound were generated by passing air at the rate of 20 liters per minute through the compound contained in a fritted bottom gas bubbler. In order to liquify the compound the bubbler was immersed in a hot water bath at approximately 90°C. The vapors emerging from the bubbler were introduced into the chamber without dilution. Thus the rats were exposed to an atmosphere essentially saturated with the volatile components of the compound. The concentration of the vapor in the chamber atmosphere (2.29 mg/l) was calculated from the ratio of the weight of compound vaporized in one hour (2.75 grams) to the total volume of air bubbled through the liquified material during the same period (1200 liters).

what did it measure by analysis?

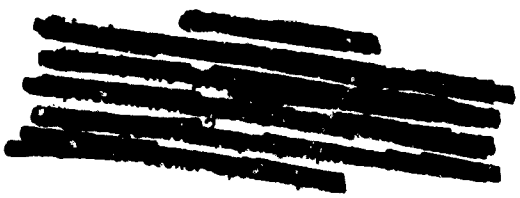
[redacted]

163-502

C. OBSERVATIONS:

Observations for pharmacotoxic signs and mortality were made during and immediately following the 1 hour exposure period and daily thereafter for 14 days. Individual body weights were recorded prior to the 1 hour exposure and periodically thereafter in order to detect any transient effects following the exposure.

PAGE 0042



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IV. RESULTS

A. ANIMAL OBSERVATIONS:

The immediate response of the rats to the experimental atmosphere was an increase of activity in preening. After several minutes of exposure, the rats began to settle down. All rats appeared normal throughout the exposure period and during the 14 day postexposure observation period. rats exhibited normal weight gain following the exposure and the 14 day observation period. (See Table 1.)

what did autopsy/microscopic) of lungs show?

B. MORTALITY:

There were no deaths during the experimental period.

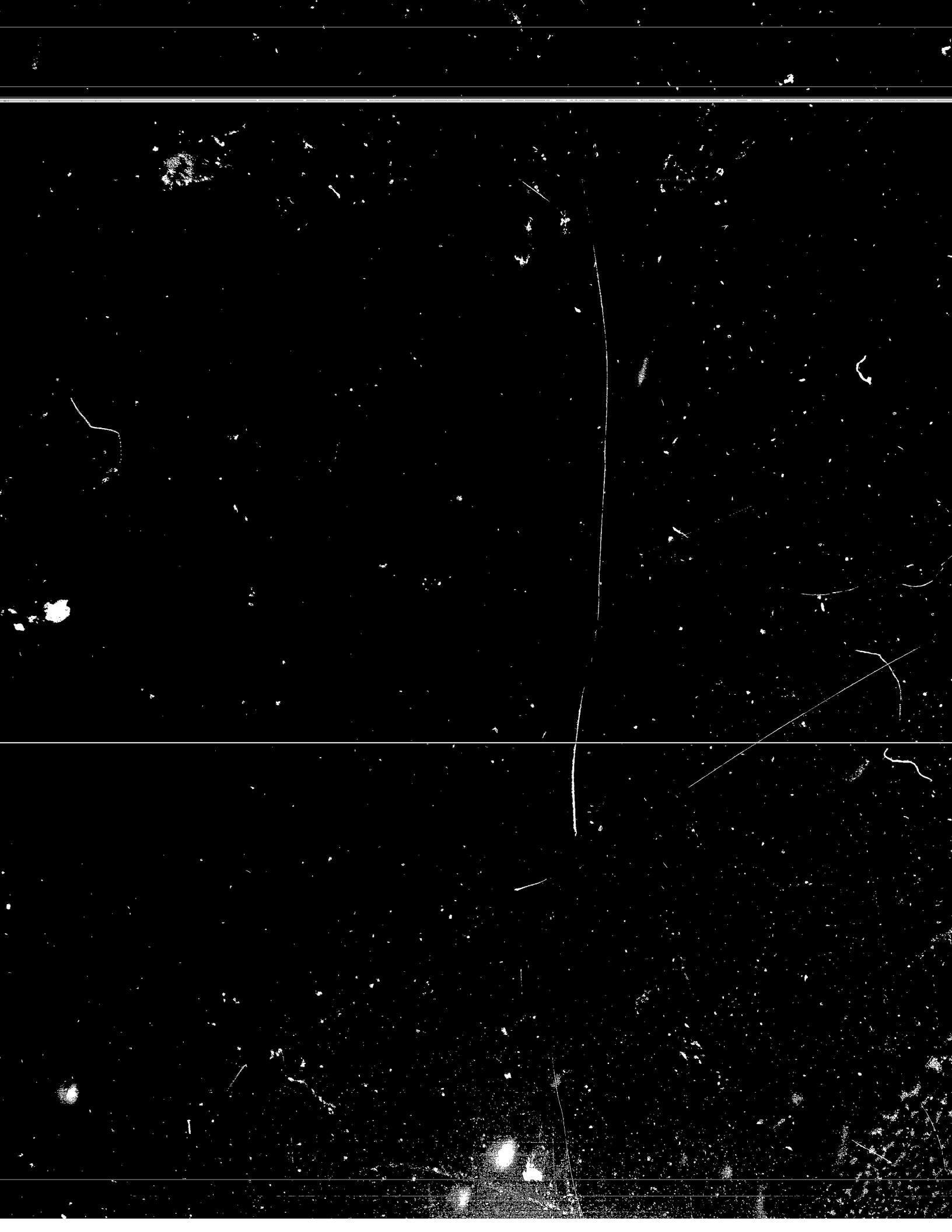
PAGE 0043

[redacted]

CN-110-109: DDT Acute Inhalation Toxicity Study in Rats.

TABLE 1. Individual Body Weights, grams.

Nominal Concentration, Rat Number	Sex	Study Days 1	2	5	7	9	12	14	15
		Number of Exposures 0	1	-	-	-	-	-	-
2.29 mg/l:									
69004	M	234	234	250	270	275	288	300	299
69005	M	242	240	260	280	281	296	309	311
69006	M	229	232	248	264	268	283	300	300
69007	M	221	229	241	264	270	287	291	295
69008	M	234	235	255	276	278	291	305	305
6900	F	212	212	222	233	234	235	240	241
6901	F	208	203	200	211	210	209	221	219
690	F	213	211	214	227	224	226	231	232
690	F	214	216	217	227	228	232	232	232
690	F	218	227	230	245	248	248	251	253



MADISON, WISCONSIN

CN-100-680

88-7800184

FM-680

8EHQ-0678-0184-(D)

Michigan Chemical Company

28 Day Rat Feeding Study

PAGE 0045

Sample 4884

What was tested?

~~by not submitting statistical data for significance they are adding to their work load. Probably low toxicity for short term but no data to show this.~~

margin comments
Joseph Seifter
July 5, 1978

WARF Institute, Inc.
Madison, Wisconsin

1) has some toxicity
2) accumulates in fat + stays there for some time

[redacted]

Declassified
8-22-78

FORM 20-4

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0016

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PAGE 0046

MADISON, WISCONSIN
Reports are submitted to clients on a confidential basis. No reference to the work, the results or to the Institute in any fo
of advertising, news release or other public announcement may be made without written authorization from the Institut

REPORT

INTRODUCTION

A sample from Michigan Chemical Corporation No. 4884 was submitted to WARF Institute, Inc., by Mr. R. C. Nametz, Michigan Chemical Corporation, St. Louis, Michigan, to evaluate effects on rats with 28-day supplemental feeding and study tissue residue deposition and clearance.

This report includes data covering effects on body weight, feed consumption, blood changes, residue analysis and histology.

PAGE 004

OBJECTIVE

To determine the sub-acute toxicity of Michigan Chemical Compound at various levels of supplementation and to screen for the possibility of tissue residue.

PROCEDURE

Male weanling rats weighing 50 ± 10 grams were randomly allotted to groups, 25 to the negative control group and 15 to each test group. Control animals were fed the basal ration alone and the test animals were supplemented with a test sample in basal ration at 100 and 1000 ppm.

A ground commercial laboratory meal constituted the basal ration.

Proximate analysis - Basal ration	
Crude protein - minimum	23.0%
Crude fat - minimum	4.5%
Crude fiber - maximum	6.0%
Ash minimum	9.0%

Weekly body weights and feed consumption were recorded.

At seven days and four weeks on test, clinical studies were

0 0 1 8

conducted on the first five rats of each group. Five rats from each group were sacrificed on day 28. Histological examination was conducted on tissues from all animals. Muscle, liver and fat were collected from all the animals for residue screening.

Remaining animals from all groups were continued on basal ration and two rats in each group were sacrificed at two and six weeks post treatment. Remaining rats were maintained on basal ration for further examination if required. Because sufficient tissue for residue analysis was not collected at the two week withdrawal time, an additional set of animals was set up, fed four weeks and placed on basal for two weeks to obtain additional tissue. This additional study is referred as 6 weeks re-run in the report.

RESULTS AND DISCUSSION

how measured? What BMR + R Rapparatus was used?

Body weights and feed consumption are presented in Tables 1 to 5. Rats in the test group have a decrease in body weight gain and a slightly poorer feed efficiency. The body weight differences between control and test animals lessened or was completely lost during the withdrawal period.

another "body reaction" due to what?

Clinical data is presented in Tables 6 through 10. The WBC is slightly increased for the test groups at day seven but returned to normal at terminal sacrifice. This effect might be due to an initial body reaction to this particular compound at that level. Blood chemistry and urinalysis at seven days and terminal sacrifice show no significant differences between contol and test and appear to be within normal ranges.

meaning what? The body has reacted by poor gain in body wt + poor growth

Organ weight data is presented in Tables 11, 12 and 13. The ratios indicate a definite difference between test and control

statistics

irrational argument

animals with regards to the size of the organs. In general, all organ weights are decreased in the test animals compared to the control. This effect seems to be more pronounced in the 1000 ppm level. In view of the lack of histopathologic or clinical effects, the difference between organ weights of test and control animals is questionable as to the toxic effect, since the food consumption weekly body weight gains and feed efficiency are only slightly lower in the test animals.

Histopathology indicates minimum lesions mainly in liver and kidneys. Cloudy swelling and nephrosis are common features. Such lesions were noted in both control and test animals, are likely to be spontaneous and not related to the administration of test samples.

Residue data on compound 4884, Table 14, show definite moderate residues in muscle, liver and fat at zero withdrawal. After two weeks withdrawal, liver samples were negative for detectable residues and muscle and fat showed a definite decrease in residue level. After six weeks, only one muscle sample from an animal receiving 1000 ppm showed low residue level (0.1 ppm), livers were again negative and fats were markedly lower in residue level. Twelve and eighteen week withdrawal values for liver and muscle residues are zero. The fat residue values for the twelve week period are on the average decrease for both the 100 and 1000 ppm levels. The eighteen week average values are somewhat elevated for both the 100 and 1000 ppm levels but are still greatly reduced from the two week and six week withdrawal periods.

SUMMARY

Michigan Chemical Sample No. 4884 was supplemented in the diet to male weanling rats for 28 days at 100 and 1000 ppm. Weekly body

0 0 2 0

weights and feed consumption were recorded. One week and terminal blood clinicals and urine analyses were conducted. On day 28, five rats from each control and test group were sacrificed, organ weights were recorded, histological examination and residue screening of the tissues were conducted. Two more rats from each group were sacrificed at two weeks and six weeks, post treatment for residue analysis.

FDA 050

Data presented on the study with the test sample indicates some effect on body weight gain and a notable decrease in some organ weights. These changes were most evident with the 1000 ppm level. The lack of clinical and histopathological effects indicate the effects noted were minimal. Data on body weight gain and food consumption during the withdrawal period showed a recovery in those instances where differences between control and test groups were noted during the test feeding period. This would indicate the body weight effect was the result of palatability or at most, a minimal reversible or transient toxic effect.

Tissue residue data for groups receiving sample 4884 indicated moderate residues in muscle, liver and fat at zero hour withdrawal and much lower residue levels in all tissues at the two weeks withdrawal. After six weeks withdrawal, all residues were markedly reduced or negative in all tissues except the fat tissue which still had a low level residue. The twelve and eighteen week average withdrawal values for liver and muscle are zero while the fat residue values are much lowered over the six week withdrawal period.

Signed Paul O. Ellis

By and for WARF Institute, Inc.

Date: December 22, 1972

0 0 2 1

Sample: 4884 Michigan Chemical Corp WARF NO. 2071960

Table 1
Body Weights (Gm)

Average Individual-weekly

Sample Description	Body Weights (gms)				
	0 week	1 week	2 weeks	3 weeks	4 weeks
Negative Control	49	80	123	170	210
100 ppm	48	77	118	158	189
1000 ppm	50	70	120	162	200

test significance? ranges? means?

051

FORM 20-4

0022

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 2
Weight Gain (Gm)

Average Individual-weekly

Sample Description	Weight Gain (gms) 1 week	2 weeks	3 weeks	4 weeks	Total
Negative Control	31	43	47	40	161
100 ppm	29	41	40	31	141
1000 ppm	20	50	42	38	150

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0023

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 3
Body weight (gm)

Average Individual-weekly
Re-run Animals

Sample Description	Weeks 0	1	2	3	4	5*	6*
Negative Control	51	72	124	153	191	221	252
100 ppm	54	68	115	153	186	227	260
1000 ppm	52	74	119	156	191	232	268

PAGE 0053

* Post treatment weeks - animals on unsupplemented basal ration.

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Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 4
Feed Consumption (gm)

Average Individual-weekly

Sample Description	Feed Consumption (gms) 1 week	2 weeks	3 weeks	4 weeks	Total
Negative Control	76	108	135	140	459
100 ppm	75	116	132	130	453
1000 ppm	76	113	138	140	467

Sample Description	Withdrawal Feed Consumption (gms) 1 wk	2 wk	3 wk	4 wk	5 wk	6 wk	Total
Negative Control	167	164	164	154	165	182	996
100 ppm	159	157	163	150	157	174	906
1000 ppm	164	162	176	161	169	190	1022

FORM 20-4

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Series 4684 Michigan Chemical Corp WARF No. 2071960

Table 5
Feed Efficiency*

Average Individual-weekly

Sample Description	Feed Efficiency (ratio)				
	1 week	2 weeks	3 weeks	4 weeks	4 wk cumulative
Negative Control	2.5	2.5	2.9	3.5	2.9
100 ppm	2.6	2.8	3.3	4.2	3.5
1000 ppm	3.8	2.3	3.5	3.7	3.1

* Grams feed consumed / Grams Gained

0 0 2 6

Sample: 4894 Michigan Chemical Corp. WARF No. 2071960

Table 6

Hematology

Animal Number	7 Day RBC [1] /mm^{3}x10^6	7 Day WBC [2] /mm^{3}x10^6	7 Day Hb[3] g%	7 Day PCV[4] %	Terminal RBC [1] /mm^{3}x10^6	Terminal WBC [2] /mm^{3}x10^6	Terminal Hb[3] g%	Terminal PCV[4] %
				Negative Control				
26112	5.78	21.4	12.4	46	6.13	18.5	13.7	49
26113	5.32	18.7	12.8	39	6.35	11.2	13.6	50
26114	5.40	25.7	13.2	46	6.38	30.5	15.0	50
26115	5.19	19.3	11.7	42	6.23	16.5	12.9	47
26116	5.81	14.0	12.0	34	6.64	16.2	13.4	53
Ave.	5.50	19.8	12.4	41	6.35	18.6	13.7	50
				100 ppm				
26181	5.68	17.1	12.3	45	6.23	17.1	14.2	50
26182	5.85	29.2	12.6	43	6.38	19.2	14.0	55
26183	5.74	29.2	11.7	42	6.88	18.6	15.0	55
26184	5.89	19.2	12.0	39	6.52	23.3	15.0	55
26185	6.31	17.7	12.1	41	6.23	22.6	13.9	53
Ave.	5.89	22.5	12.1	42	6.45	20.1	14.4	54
				1000 ppm				
26196	6.06	46.4	12.3	43	6.79	19.4	14.0	52
26197	5.77	41.0	11.8	40	5.88	19.8	14.2	50
26198	6.36	29.4	12.3	46	6.27	18.1	14.2	51
26199	5.89	24.6	11.0	40	6.36	22.3	13.9	52
26200	6.32	22.3	12.4	40	6.25	17.8	14.2	52
Ave.	6.08	32.7	12.0	42	6.31	19.5	14.1	51

[1] Red Blood Cells
[2] White Blood Cells
[3] Hemoglobin
[4] Pack Cell Volume

Sample: 4804 Michigan Chemical Corp. WARF No. 2071960

Table 7

Blood Chemistry - 7 days

Animal Number	sGOT IU	BUN mg %	Total Protein grams	Diphosphoglycerate u moles/ml
			Negative Control	
26112	108	21	5.8	3.1
26113	96	15	5.4	2.8
26114	86	23	5.4	3.1
26115	106	18	5.4	2.9
26116	100	18	6.3	3.0
Ave.	99	19	5.7	3.0
			100 ppm	
26181	115	17	5.7	2.7
26182	100	13	5.8	3.1
26183	88	18	5.2	3.2
26184	102	18	5.1	2.7
26185	100	18	5.6	2.7
Ave.	100	17	5.5	2.9
			1000 ppm	
26196	86	19	5.6	3.0
26197	130	18	5.4	2.5
26198	100	16	5.2	3.1
26199	100	16	5.2	3.1
26200	90	17	5.6	3.1
Ave.	101	17	5.4	3.0

sGOT - serum Glutamic Oxalacetic Transaminase
BUN - Blood Urea Nitrogen

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 8

Blood Chemistry-Terminal

Number	sGOT IU	BUN mg %	Total Protein grams	Diphosphoglycerate u moles/ml
			Negative Control	
26112	80	18	7.4	3.9
26113	96	18	7.2	3.9
26114	96	18	7.0	4.2
26115	80	17	6.8	3.0
26116	88	19	6.8	3.3
Ave.	88	18	7.0	3.7
			100 ppm	
26181	80	16	6.9	3.4
26182	96	18	7.4	3.2
26183	96	17	6.9	4.3
26184	110	23	7.2	3.3
26185	110	17	7.1	3.0
Ave.	98	18	7.1	2.8
			1000 ppm	
26196	110	19	7.1	3.2
26197	80	19	7.2	3.0
26198	125	17	7.0	4.0
26199	110	16	6.8	3.9
26200	80	15	7.4	4.1
Ave.	101	17	7.1	3.6

sGOT - serum Glutamic Oxalacetic Transaminase
BUN - Blood Urea Nitrogen

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0029

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 9

Urine Analysis - 7 day

Animal Number	Blood	Bilirubin	Ketones	Glucose	Albumin	pH
Negative Control						
26112	-	-	-	-	30	6.5
26113	-	-	-	-	-	6.5
26114	-	-	-	-	30	7.0
26115	-	-	-	-	30	7.0
26116	-	-	trace	-	30	6.5
100 ppm						
26181	-	-	trace	-	trace	6.5
26182	-	-	-	-	trace	6.5
26183	-	-	-	-	30	6.0
26184	-	-	-	-	trace	6.0
26185	-	-	-	-	30	6.0
1000 ppm						
26196	-	-	-	-	-	6.5
26197	-	-	trace	-	-	6.5
26198	-	-	trace	-	-	6.0
26199	-	-	-	-	-	6.0
26200	-	-	-	-	-	6.0

PAT 0059

FORM 28-4

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0 0 3 0

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 10

Urine Analysis - Terminal

Animal Number	Blood	Bilirubin	Ketones	Glucose	Albumin	pH
			Negative Control			
26114	-	trace	-	-	trace	6.5
26120	-	-	-	-	-	7.5
26121	-	-	-	-	-	5.5
26123	-	-	-	-	trace	6.5
26124	-	-	-	-	-	5.5
			100 ppm			
26185	-	-	-	-	30	6.0
26186	-	-	-	-	30	6.0
26187	-	-	-	-	-	7.0
26188	-	-	-	-	trace	7.0
26189	-	-	-	-	-	5.5
			1000 ppm			
26198	-	-	trace	-	-	5.5
26202	-	-	-	-	30	5.5
26207	-	-	-	-	-	5.5
26209	-	-	-	-	30	7.0
26210	-	-	-	-	-	7.0

0900

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FORM 10-A

0031

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 11
Organ Weight (gm)

Individual Values

Animal Number	B.W.	Heart	Liver	Spleen	Kidney	Gonads
			Negative Control			
26111	194	0.975	9.20	0.741	2.193	2.542
26112	229	1.224	13.10	0.948	2.793	2.884
26113	207	1.302	12.20	1.077	2.783	2.894
26114	195	1.469	12.00	0.910	2.451	2.928
26115	201	0.987	11.50	0.860	2.343	2.792
Ave.	205	1.191	11.60	0.907	2.513	2.808
			100 ppm			
26181	209	0.941	9.20	0.721	2.312	2.646
26162	200	1.032	8.91	0.582	2.194	2.811
26183	193	1.140	9.40	0.674	2.339	2.374
26184	175	0.810	9.30	0.559	1.939	2.378
26185	210	1.095	11.20	0.613	2.283	2.352
Ave.	197	1.004	9.56	0.629	2.213	2.512
			1000 ppm			
26196	191	0.890	7.60	0.643	1.903	2.399
26197	224	1.034	10.40	0.737	2.367	2.690
26198	179	0.716	7.70	0.568	2.053	2.135
26199	197	0.036	8.75	0.697	2.154	2.510
26200	188	0.888	9.00	0.706	2.070	2.472
Ave.	196	0.893	8.69	0.670	2.109	2.441

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Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 12

Organ Weight Expressed as % of Body Weight

Individual Values

Animal No.	Heart	Liver	Spleen	Kidney	Gonads
Negative Control					
26111	0.503	4.74	0.382	1.13	1.31
26112	0.534	5.72	0.414	1.22	1.26
26113	0.629	5.89	0.520	1.34	1.39
26114	0.753	6.15	0.467	1.26	1.50
26115	0.491	5.72	0.428	1.17	1.39
Average	0.582	5.64	0.442	1.22	1.37
100 ppm					
26181	0.450	4.40	0.345	1.17	1.27
26182	0.516	4.46	0.291	1.09	1.41
26183	0.590	4.87	0.349	1.21	1.23
26184	0.463	5.31	0.319	1.11	1.36
26185	0.521	5.33	0.292	1.09	1.12
Average	0.508	4.87	0.319	1.13	1.28
1000 ppm					
26196	0.466	3.98	0.337	0.99	1.26
26197	0.462	4.64	0.329	1.06	1.20
26198	0.400	4.30	0.317	1.15	1.19
26199	0.475	4.44	0.354	1.09	1.27
26200	0.472	4.79	0.376	1.10	1.32
Average	0.455	4.43	0.343	1.08	1.25

important to apply significance tests

WARF 0062

0 0 3 3

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 13
Organ Weights

T-Test Values

	Heart	Liver	Spleen	Kidney	Gonads
100 ppm	t=1.3441 p>0.05	t=2.4727 0.05<p<0.02	t=4.5875 0.01<p<0.02	t=2.0637 p>0.05	t=1.3122 p>0.05
1000 ppm	t=2.4869 0.05<p<0.02	t=4.3771 0.01<p<0	t=3.8470 0.01<p<0	t=3.2485 0.02<p<0.01	t=2.3754 0.05<p<.02

1000 ppm appears to interfere with ~~weights~~ growth of these organs; 100 ppm with liver and spleen. Effect on reticuloendothelial system?

FORM 20-4

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Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 14
Residue Analysis

ppm of Sample in Tissue

Individual Values

Animal Number	Withdrawal Time (wks)	Feeding Level ppm	ppm 4884 Muscle	Liver	Fat
26111	0	0	-	-	-
26112	0	0	-	-	-
26113	0	0	-	-	-
26114	0	0	-	-	-
26115	0	0	-	-	-
Average					
26181	0	100	0.14	0.05	0.70
26182	0	100	0.29	<0.05	5.89
26183	0	100	0.24	0.16	6.30
26184	0	100	0.14	<0.05	6.62
26185	0	100	0.28	0.082	5.72
Average			21.8	0.08	5.05
26196	0	1000	0.79	0.050	19.5
26197	0	1000	0.55	0.14	19.8
26198	0	1000	0.38	0.082	26.0
26199	0	1000	0.85	0.11	8.3
26200	0	1000	0.75	0.12	10.7
Average			0.66	0.10	16.86
28485	2	100	0.083	-	8.45
28486	2	100	0.50	-	7.79
28487	2	100	0.063	-	4.41
Average			0.21		6.88
28488	2	1000	0.21	-	18.9
28489	2	1000	1.00	-	16.5
28490	2	1000	1.05	-	15.4
Average			0.75		16.93
26189	6	100	-	-	1.96
26190	6	100	-	-	1.03
Average					1.50

accumulates in fat

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FORM 28-4

0 0 3 5

Sample: 4884 Michigan Chemical Corp. WARF No. 2071960

Table 14 (continued)
Residue Analysis

ppm of Sample in Tissue

Individual Values

PAT 0065

Animal Number	Withdrawal Time (wks)	Feeding Level ppm	ppm 4884 Muscle	Liver	Fat
26204	6	1000	0.10	-	3.73
26205	6	1000	-	-	7.04
Average			.05		5.38
26122	12	0	-	-	-
26191	12	100	-	-	1.11
26192	12	100	-	-	0.96
Average					1.04
26206	12	1000	-	-	1.98
26207	12	1000	-	-	1.98
Average					1.98
26186	18	100	-	-	3.04
26195	18	100	-	-	0.80
26193	18	100	-	-	1.20
26194	18	100	-	-	0.75
Average					1.45
26201	18	1000	-	-	4.07
26210	18	1000	-	-	0.62
26208	18	1000	-	-	3.94
26209	18	1000	-	-	5.0
Average					3.41

0 0 3 6

Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification

Date of death 9-7-72 Terminal B. W. _____ g. Weeks on test or age 4 Study ident. [illegible]

[X] Gross observations: Cause of Death

NRA – (no remarkable alterations)

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Din

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes N

Salivary glands N - N

Thyroid & parathyroid

Lungs mild diffuse congestion.

Heart N

Spleen N

Liver diffuse mild cloudy swelling

Stomach N

Small intestine – 3 levels N N

Colon N

Mesenteric lymph nodes N

Pancreas N N

Adrenals N

Kidneys mild congestion of medulla, [illegible] areas of vacuolization in tubules.

Gonads T- numerous atrophic deg. tubules

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/25/72 Pathologist [signature]

FORM 32

DONALD L. HARRIS DVM

65

0037

Terminal B. W. _____ g. Weeks on test or age 4 Study ident. Mich. Chemical

☒ Gross observations: Cause of Death —

NRA

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Din

☒ Histologic observations:

PAGE 0061

Brain N

Pituitary N

Lymph nodes

Salivary glands very deg.

Thyroid & parathyroid N - N

Lungs N

Heart N

Spleen N

Liver severe diffuse Cloudy swelling + some vacuolization

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes N

Pancreas very intense staining - blue cyto at periphery + red cyto at lumen (centroacinar)

Adrenals N

Kidneys severely deg tubules + deg. atrophic glomeruli

Gonads T. few atrophic deg. tubules.

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/25/72 Pathologist Harris

FORM 32

66

0038

Date of death [illegible] Terminal B. W. _____ g. Weeks on test or age 4 Identification [illegible]
Study ident. Mich. Chemical Co.

☒ Gross observations: Cause of Death _____

NRA

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris and Dim
Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____
(L) _____ (L) _____
Femur lgth. _____ mm

☒ Histologic observations:

Brain N

Pituitary N

Lymph nodes

Salivary glands degenerate

Thyroid & parathyroid 20-30% colloid

Lungs N

Heart N

Spleen N

Liver swollen - diffuse severe cloudy swelling & vacuolization

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes N

Pancreas lab # 26-117

Adrenals N

Kidneys few small atrophic glomeruli

Gonads

Urinary bladder N

Uterus or prostate N

Muscle (skeletal)

Bone Marrow

Bone

Date _____ 9/25/72 Pathologist [signature]

ORM 32

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0034

Rat Path. No. _____ Sex ☒ M ☐ F Late ☐ D ☒ S ☐ T Identification [illegible]
Date of death _____ Terminal B. W. _____ g. Weeks on test or age 4 Study ident [illegible]

☒ Gross observations: Cause of Death _____

NRA

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Examined By: Harris and Dix
Femur lgth. _____ mm

☒ Histologic observations:

Brain N N

Pituitary

Lymph nodes N

Salivary glands N

Thyroid & parathyroid N very cellular – 10-20% colloid

Lungs N

Heart N

Spleen N

Liver diffuse moderate cloudy swelling w/some vacuolization

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes N

Pancreas like # 26112

Adrenals ~~like # 26112~~ N

Kidneys congestion of medulla

Gonads T-numerous leg. atrophic tubules

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/25/72 Pathologist [signature]

FORM 32

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0040

Rat Path. No. 26115 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification 117 203
Date of death 9-7-72 Terminal B. W. _____ g. Weeks on test or age 9 Study ident. Michigan Chem. Co

[X] Gross observations: Cause of Death _____

NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Dim

[ ] Histologic observations:

Brain N

Pituitary N

Lymph nodes

Salivary glands degenerate

Thyroid & parathyroid 30-40% colloid

Lungs N

Heart N

Spleen N

Liver swollen - moderate diffuse cloudy swelling

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas degenerate

Adrenals N

Kidneys degenerate atrophic glomeruli

Gonads T-few atrophic deg. tubules

Urinary bladder N

Uterus or prostate N

Muscle (skeletal)

Bone Marrow

Bone

Date 9/7/72 Pathologist [signature]

FORM 32

69

0041

Date of death 2-26-72 Terminal B. W. _____ g. Weeks on test or age 6 Identification _____
Study ident. Michigan Chem. Co.

☒ Gross observations: Cause of Death _____

No remarkable alterations (NRA)

☒ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris & Dinn
Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____
(L) _____ (L) _____
Femur lgth. _____

☒ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

~~Pancreas~~

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date _____ Pathologist _____

FORM 32

DONALD J. HARRIS, DVM

70

0042

Date of death 9-26-72 Terminal B. W. _____ g. Weeks on test or age 6 Identification _____ Study ident. Michigan Chem. C.

☒ Gross observations: Cause of Death _____

NRA.

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Din

☒ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date _____ Pathologist _____

FORM 32

71

0043

Date of death 10-20-72 Terminal B. W. 35[illegible] g. Weeks on test or age [illegible] Identification [illegible]

Study Ident. [illegible]

☒ Gross observations: Cause of Death _____

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____

Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____

Examined By: Harris and Din

Femur lgth. _____ mm

☐ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date _____ Pathologist _____

FORM 32

0044

Date of death 10-20 72 Terminal B. W. — g. Weeks on test or age 6 wks post treatment Identification [illegible] Study ident. Michigan Chem. Co.

☒ Gross observations: Cause of Death

☐ Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____
Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____
Femur lgth. ____ mm

Examined By: Harris and Din

☐ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date ____ Pathologist ____

FORM 32

73

0045

Rat Path. No. 2 C 15 3 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 2 1 3

Date of death 7-7-72 Terminal B. W. _____ g. Weeks on test or age 4 Study Idem. [illegible]

[X] Gross observations: Cause of Death _____

NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____

Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____

Examined By: Harris and D[illegible]

Femur lgth. _____ mm

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes N

Salivary glands N

Thyroid & parathyroid → N very cellular - little colloid present - 10%

Lungs N

Heart N

Spleen N

Liver diffuse mild cloudy swelling

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys N

Gonads T-N

Urinary bladder

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date _____ Pathologist _____

FORM 32

70

0046

Rat Path. No. 26184 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT203
Date of death 7-7-72 Terminal B.W. ____ g. Weeks on test or age 4 Study Ident. [illegible]

[X] Gross observations: Cause of Death ____

NRA

Examined By: Harris and Dix

[ ] Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____
Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____
Femur lgth. ____ mm

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes N

Salivary glands N

Thyroid & parathyroid

Lungs N

Heart N

Spleen N

Liver diffuse mild C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys mildly degenerate tubules

Gonads T – N

Urinary bladder

Uterus or prostate N

Muscle (skeletal)

Bone Marrow

Bone

Date ____ Pathologist [signature] 9/20/72

FORM 32

0047

Rat Path. No. 26185 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T

Date of death _____ Terminal B. W. _____ g. Weeks on test or age _____ Identification MT203

[X] Gross observations: Cause of Death _____ Study ident. Michigan Chem. Co.

NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris & Dein

Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____

(L) _____ (L) _____

Femur lgth. _____ mm

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes

Salivary glands N

Thyroid & parathyroid very cellular - 20% colloid

Lungs N

Heart N

Spleen N

Liver slightly swollen - diffuse moderate C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys numerous small atrophic dig. glomerule

Gonads T-N

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/26/72 Pathologist [signature]

FORM 32

0048

Rat Path. No. _____ Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification TCT 203
Date of death 7-26-72 Terminal B.W. _____ g. Weeks on test or age 6 Study ident. Michigan Chem.

[ ] Gross observations: Cause of Death _____

NRA

Examined By: Harris and Din

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

[X] Histologic observations:

PAGE 0080

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

79

Date _____ Pathologist _____

FORM 32

0049

Rat Path. No. 21187 Sex ☒M ☐F Fate ☐D ☒S ☐T Identification MT203

Date of death 7-26-72 Terminal B.W. _____ g. Weeks on test or age 6 Study ident. Michigan Chem. Co.

☐ Gross observations: Cause of Death NRA

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Ben

☒ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

80

Date _____ Pathologist _____

FORM 32

0 0 5 0

Rat Path. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 203

Date of death 10-20-72 Terminal B.W. 371 g. Weeks on test or age 2 weeks post treatment Study Ident. Michigan Chem Co.

[X] Gross observations: Cause of Death _____

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____

Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____

Examined By: Harris and Din

Femur lgth. _____ mm

[ ] Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

PAGE 0082

81

Date _____ Pathologist _____

FORM 32

0051

Rat Path. No. [illegible] Sex ☒M ☐F Fate ☐D ☒S ☐T Identification M/203

Date of death 6-21-78 Terminal B. W. 320 g. Weeks on test or age 2 [illegible] Study ident [illegible]

☒ Gross observations: Cause of Death [illegible]

☐ Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Examined By: Harris and Dix
Spleen ____ Thyroid ____ (L) ____ Adrenal (R) ____ Gonad (R) ____
(L) ____ (L) ____
Femur lgth. ____ mm

☐ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date ____ Pathologist ____

FORM 32

82

0 0 5 2

Nat. Path. No. _____ Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 203

Date of death 7-7-72 Terminal B. W. _____ g. Weeks on test or age 4 Study ident. Michigan Ch...

[X] Gross observations: Cause of Death _____

Anemic. pale colored organs.

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____

Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____

Examined By: Harris and Din

Femur lgth. _____ mm

PAGE 0084

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes

Salivary glands N

Thyroid & parathyroid N ? very cellular - 10-20% colloid - appears dg.

Lungs N

Heart N

Spleen N

Liver diffuse mild C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys numerous small atrophic dg. glomerule

Gonads T - few dg tubules

Urinary bladder N

Uterus or prostate N

Muscle (skeletal)

Bone Marrow

Bone

Date 9/27/72 Pathologist [signature]

FORM 32

83

0053

Terminal B. W. _____ g. Weeks on test or age 4 Identification MT 203

☒ Gross observations: Cause of Death _____ Study ident. Mississippi Chem. I

MISH

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris and Dix

Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____

(L) _____ (L) _____

Femur lgth. _____ mm

☒ Histologic observations:

Brain N

Pituitary

Lymph nodes

Salivary glands N

Thyroid & parathyroid very cellular - 10-15% colloid

Lungs N

Heart N

Spleen N

Liver diffuse moderate C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys degenerate tubules & glomeruli (diffuse moderate)

Testis T-N

Urinary bladder N

Seminal or prostate N

Bone (skeletal) N

Bone marrow N

MF 0085

9/21/72 Pathologist Harris

84

0 0 5 4

Rat Path. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT203

Date of death 9-7-72 Terminal B. W. _____ g. Weeks on test or age 4 Study ident. [illegible]

[X] Gross observations: Cause of Death _____

NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris and Dim

Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____

(L) _____ (L) _____

[X] Histologic observations: Femur lgth. _____ mm

Brain N

Pituitary N

Lymph nodes

Salivary glands

Thyroid & parathyroid hyperauth - 90% colloid.

Lungs N

Heart N

Spleen N

Liver diffuse mild C.S.

Stomach N

Small intestine – 3 levels N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys severely dy - tubules & glomeruli

Gonads T-N

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/27/72 Pathologist Harris

FORM 32

85

0 0 5 5

Test Rqm. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 203

Date of death 7-7-72 Terminal B. W. ____ g. Weeks on test or age 4 Study ident. Michigan Chem. Co.

[X] Gross observations: Cause of Death

NRA

[ ] Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____

Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____

Examined By: Harris and P. Di[illegible]

Femur lgth. ____ mm

[X] Histologic observations:

Brain N

Pituitary ~~[illegible]~~

Lymph nodes N

Salivary glands N

Thyroid & parathyroid N - 40% colloid

Lungs N

Heart N

Spleen N

Liver diffuse moderate C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals

Kidneys N

Gonads T-N

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/23/71 Pathologist [signature]

FORM 32

86

MGE 0087

0056

Rat Path. No. 20200 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 203

Date of death _____ Terminal B. W. _____ g. Weeks on test or age _____ Study ident. Michigan Chem

[X] Gross observations: Cause of Death _____

NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Examined By: Harris and Di

Spleen _____ Thyroid _____ (L) _____ Adrenal (R) _____ Gonad (R) _____

(L) _____ (L) _____

Femur lgth. _____ mm

0088

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes N

Salivary glands N

Thyroid & parathyroid deg - 40% colloid

Lungs N

Heart N

Spleen N

Liver diffuse moderate C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas ? numerous black laminated concretions + other pigment

Adrenals N

Kidneys few deg atrophic tubules

Gonads T-N

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 9/27/72 Pathologist Harris

FORM 32

87

0057

Date of death 9-26-72 Terminal B. W. _____ g. Weeks on test or age 6 Identification M1203
Study ident. Michigan Chem. Co.

☒ Gross observations: Cause of Death _____

NRA

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Examined By: Harris and Dim
Femur lgth. _____ mm

☒ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine -- 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date _____ Pathologist _____

FORM 32

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0058

Date of death 7-26-72 Terminal B. W. _____ Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Weeks on test or age 6 Identification M 1 2 0 3 Study ident. Michigan Chem. C

[X] Gross observations: Cause of Death NRA

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

Examined By: Harris and Din

[X] Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

Date _____ Pathologist _____

FORM 32

PAGE 0090

PAGE 00

0 0 5 9

Date of death 2-26-72 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification M1203

[X] Gross observations: Cause of Death NRA

[ ] Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____
Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____
Femur lgth. ____ mm

Examined By: Harris and Di...

[X] Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

PAGE 0091 (001)

PAGE 0091

Date ____

FORM 32

Pathologis: ____

90

0 0 6 8

Rat Path. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification 117303

Date of death _____ Terminal B. W. 310 g. Weeks on test or age 2 weeks post treatment Study ident. Michigan Chem. Corp.

[X] Gross observations: Cause of Death _____

Examined By: Harris and Dim

[ ] Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

[ ] Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

PAGE 0092

Date _____ Pathologist _____

FORM 32

0 0 6 1

Rat Path. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification 171-203

Date of death [illegible] Terminal B. W. 343 g. Weeks on test or age _____ Study ident. Michigan Chem. Corp.

☒ Gross observations: Cause of Death _____

Examined By: Harris and Din

☐ Organ wts. (in gms.): Liver _____ Heart _____ Kidney (R) _____ Adrenal (R) _____ Gonad (R) _____
Spleen _____ Thyroid _____ (L) _____ (L) _____ (L) _____
Femur lgth. _____ mm

☐ Histologic observations:

Brain

Pituitary

Lymph nodes

Salivary glands

Thyroid & parathyroid

Lungs

Heart

Spleen

Liver

Stomach

Small intestine – 3 levels

Colon

Mesenteric lymph nodes

Pancreas

Adrenals

Kidneys

Gonads

Urinary bladder

Uterus or prostate

Muscle (skeletal)

Bone Marrow

Bone

PAGE 0093

Date _____ Pathologist _____

92

FORM 32

0062

Hat Path. No. [illegible] Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification [illegible]
Date of death [illegible] Terminal B. W. ____ g. Weeks on test or age 4 Study ident. Michigan Chem. Co

[X] Gross observations: Cause of Death

NRA

[ ] Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____
Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____
Examined By: Harris and D.
Femur lgth. ____ mm

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes

Salivary glands N

Thyroid & parathyroid N - 30-90% colloid

Lungs N

Heart N

Spleen N

Liver diffuse mild C.S.

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys N

Gonads T-N

Urinary bladder

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date 8/26/72 Pathologist Harris

FORM 32

74

0063

Rat Path. No. 26182 Sex [X] M [ ] F Fate [ ] D [X] S [ ] T Identification MT 202

Date of death 9-7-72 Terminal B. W. ____ g. Weeks on test or age 4 Study ident. Michigan Chem. Co.

[X] Gross observations: Cause of Death

NRA

[ ] Organ wts. (in gms.): Liver ____ Heart ____ Kidney (R) ____ Adrenal (R) ____ Gonad (R) ____

Spleen ____ Thyroid ____ (L) ____ (L) ____ (L) ____

Examined By: Harris and Di

Femur lgth. ____ mm

[X] Histologic observations:

Brain N

Pituitary N

Lymph nodes N

Salivary glands N

Thyroid & parathyroid N - 30-40% colloid

Lungs N

Heart N

Spleen N

Liver diffuse moderate cloudy swelling

Stomach N

Small intestine – 3 levels N N N

Colon N

Mesenteric lymph nodes

Pancreas N

Adrenals N

Kidneys N

Gonads T - few atrophic deg. tubules

Urinary bladder N

Uterus or prostate N

Muscle (skeletal) N

Bone Marrow N

Bone

Date ____ Pathologist Harris 9/26/72

FORM 32

15

0064

88-7800184

8EH9-0678-0184 (E)

TEST REPORT

PAGE 0095

CHEMICAL BIOTESTING CENTER

CHEMICALS INSPECTION & TESTING

INSTITUTE, JAPAN

93

0065

attached paper

No.1

METHOD FOR TESTING THE DEGREE OF ACCUMULATION OF CHEMICAL SUBSTANCES IN FISH BODY

I. Scope of application

The standardized method for testing the degree of accumulation of chemical substances in fish body is as follows.

II. Terminology

The terminology used in this test method is in accordance with that used in the Japanese Industrial Standards (hereinafter referred to as the "JIS").

III. Test method

III-1. Test concentration of the test compound

Prior to initiation of the test on the degree of accumulation, an acute toxicity test is made as provided below the result of which is used as reference in determining the concentration of the compound to be subjected to the test.

1. Fish used in the acute toxicity test

Mature orange-red killifish (*Oryzias Latipes*) (weighing 0.15 g to 0.5 g) is used. Diseased fish or those with abnormal external appearance and behavior should not be used.

2. Test water

The test water should be fresh underground water or dechlorinated city water sufficiently aerated so that the dissolved oxygen concentration is kept at about 7 ppm.

3. Test on acute toxicity (determination of TLm)

According to the method provided in JIS K 0102-§ 55, the test compound is dissolved in the test water (Note 1) and the 48-hours TLm (the concentration expressed in mg/l of the test compound at which 50 per cent of the test fish will die in 48 hours) is estimated and the TLm value is used as reference in determining the test concentration of the

MF 0096

0 0 6 6

attached paper
No.2

compound to be subjected to the test on the degree of accumulation.

(Note 1) If the test compound has little solubility in water, suitable solubilizers (such as ethyl alcohol, fatty acid esters of polyoxyethylene sorbitan, etc.) can be used.

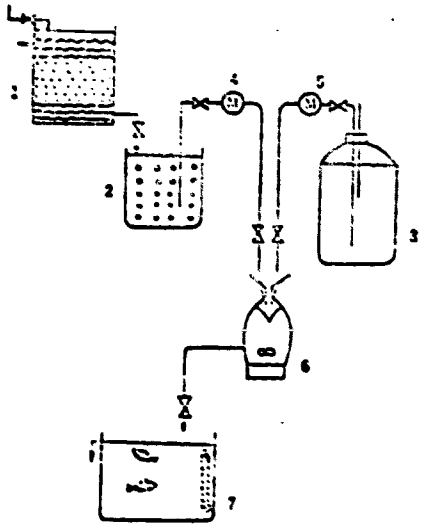
II-2. Method of test on the degree of accumulation

This test is carried out in flowing water and the degree to which the test compound is accumulated in fish bodies is examined.

1. Apparatus and equipment

(1) Apparatus

The apparatus is outlined as follws :



1. Active carbon tank for dechlorination of city water
2. Diluting-water tank in which temperature is controlled and water aerated
3. Tank for stock of solution of the test compound

MAE 0091

0 0 6 7

attached paper
No.3

4. Flow meter
5. Flow meter
6. Mixing tank
7. Aquarium of volume of 3 to 10 liters per fish, provided with temperature regulator

(2) Aquarium

The aquarium should be glass made, clean and of sufficient volume for rearing the test fish.

(3) Other apparatus

The apparatus used for water supply or dilution of the test compound should be glass made and clean as possible.

Use of plastics should be limited to the parts where it is inevitable, such as joints.

2. Test fish

Carp weighing 20 to 40 g and measuring about 10 cm in body length (Note 2) are used.

(Note 2) the length between the tip of the mouth and the base of the caudal fin.

3. Rearing and acclimating

The carp are reared in a suitable fish pond. While rearing the diseased, the weakened and those showing other abnormal signs should be eliminated. Then external or internal parasitic pathogenes are exterminated by sterilizer bathing or medication to keep the fish in good body condition and after that they are transferred to an acclimating tank.

If there is a difference between the test temperature and the water temperature of the fish pond, the fish are acclimated in the acclimating tank by the method provided in (1) or (2) below and in the meantime the fish with damages in the gills or the skin or diseased are eliminated. It is desirable

that the water in the fish pond and acclimating tank is always flowing.

(1) If the test temperature is higher than the water temperature of the fish pond, fish are acclimated for not less than a day in a temperature higher by 5°C or less than the water temperature of the fish pond. Then the temperature is gradually raised at the rate not more than 2°C/day and finally the fish are reared in the test temprature for 5 to 7 days.

(2) If the test temperature is lower than the water temprature of the fish pond, fish are acclimated for not less than a day in a temperature lower by 5°C or less than the water temperature of the fish pond, then the temperature is gradually lowered at the rate not more than 2°C/day and finally fish are reared in the test temperature for 7 to 10 days.

4. Feeding

Pelleted feed is used. (Note 3) Fish are fed 2 to 3 times daily. In order to avoid any leftover, the feed should be given slowly so that the portion of the feed floating on the water surface is entirely eaten by the test fish before it reaches the bottom of the aquarium.

(Note 3) The compound feed tainted with residual agricultural chemicals or other chemicals that might cause serious effects on the test must not be used.

5. Assessment of adequacy of test fish

The carp in the acclimating tank in which not less than 5 per cent of the whole fish have weakened or died within one week before the start of the test should not be used.

6. Test procedure

0 0 6 9

attached paper
No.5

(1) Test water and the concentration of the test compound

The test water is as provided in Ⅲ-1-2. Two levels of concentration as low as possible within the analytical limit (one of the two levels of concentration is ten times higher than the other) should be prepared. (Note 4)

The test is carried out in each of two concentration levels mentioned above, (Note 5) and at the same time blank test is made in the water in which the test compound is not dissolved. During the test period, test water is controlled so that the concentration of dissolved oxygen is kept at about 7 ppm.

(Note 4) Two concentration levels as low as possible within the analytical limit, among the levels of 1/100, 1/1000 and 1/10000 of 48-hour TLm determined in Ⅲ-1-4, will serve as a guide.

(Note 5) If the test compound has little solubility in water, suitable solubilizers (such as ethyl alcohol, fatty acid esters of polyoxyethylene sorbitan, etc.) are used.

(2) Test temperature

The test water is kept at 25±2℃.

(3) Test period

The test should be continued for 8 weeks, in principle.

However, in the case that the concentration factor calculated by the equation provided in Ⅲ-2-5(1) exceeds a given value or in the case it gives a maximum value in either one of the two levels of test concentration, the test may be discontinued.

(4) Procedure

The test fish that have met the assessment provided in Ⅲ-2-5, are reared under the conditions provided in (1)

PAGE 0100

through (3) using the apparatus and equipment provided in Ⅲ-2-1. Excretions of the carp and smudges on the wall of the aquarium should be removed about once a day throughout the test period.

7. Analysis of test fish

(1) Every one or two weeks two to three test fish are taken out not less than ten hours after feeding and subjected to analysis. The fish from the water concentration level in which the test fish have showed distinct abnormal signs during the test should not be served for analysis.

(2) The surface of fish body is wiped lightly with gauze and each fish is weighed accurately to the unit of 0.1 g.

In the next place, the whole body of each fish, in principle, is homogenated and a suitable pretreatment such as extraction and concentration, depending upon the chemical properties of the test compound, is made to prepare a sample for quantitative analysis.

The analysis is made as directed in the General Rules of Analysis provided in the JIS (gas chromatography, absorptiometry, mass spectrometry, atomic absorption spectrophotometry, etc.).

8. Calculating method of the test result

(1) The degree of accumulation, expressed by concentration factor, is calculated by the following equation.

$$CFn = \frac{Fn - FB}{W}$$

CFn : Concentration factor after n weeks

Fn : Concentration of the test compound in the fish body after n weeks in the test period

FB : Arithmetical mean concentration of the test compound

PAT 0101

0 0 7

PAC 0102

in the fish body at the start of, and at the termination of the blank test (Note 6)

W : Mean concentration of the test compound in the aquarium (Note 7)

(Note 6) In the case CFa is calculated during the test period, the concentration of the test compound in fish bodies before the start of test may be quoted as tentative FB.

(Note 7) The concentration of the test compound in the water of the aquarium is measured periodically and the arithmetical mean value of measured concentrations is used. However, the calculated concentration may be used instead if inevitable.

(2) Draw a correlation curve of the values calculated in (1), against time.

CHEMICALS INSPECTION & TESTING INSTITUTE, JAPAN

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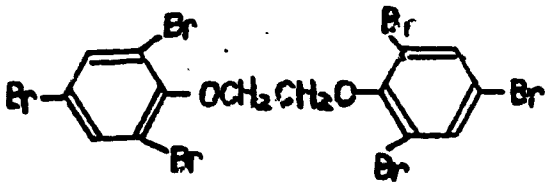
LABORATORY
ASHIKAGA, TOKYO, SHIZUOKA, NAGOYA,
OSAKA, KOBE, TOYO-OKA, OKAYAMA,
TAKAMATSU, HIROSHIMA, KURUME.

Test Report

1. Applicant : Ube - Cycon Co., Ltd.

2. Test Sample : Bis - 1.2 - (2.4.6. - Tribromophenoxy) - ethane.
structural formula



3. Scope : Measurement of the degree of accumulation of the test sample in fish body.

4. Test period : Jul. 5, 1976 - Nov. 5, 1976

5. Test method : Refer to the Items of Artical 2. of the Order Prescribing the Items of the Test Relating to New Chemical Substances (Order of the Prime Minister, the Minister of Health & Welfare and the Minister of International Trade & Industry No. 1,) " Method for testing the degree of accumulation of chemical substance in fish body."
See the attached paper.

5.1. Equipment and Analytical Instrument

5.1.1. Aquatron

Sample to be tested were dispered in water with solubilizer and supplied continuously to the mixing tank, where diluted with 100 times the volume water and introduced into test tank.
Both room and test tank temperature were controlled within 25 ± 2 C°.

0 0 7 9

CHEMICALS INSPECTION & TESTING INSTITUTE, JAPAN

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ASHIKAGA, TOKYO, SHIZUOKA, NAGOYA,
OSAKA, KOBE, TOYO-OKA, OKAYAMA,
TAKAMATSU, HIROSHIMA, KURUME.

5.1.2. Analytical instrument

Gas chromatograph, JGC-20K.

(Japan Electron Optics Laboratory Co., Ltd.)

MAF 0109

5.2. Test Condition

5.2.1. Measurement of 48-hours TLm value

(a) Test fish

Mature orange-red killfish (Orizias latipes), Passed mercuric chloride test.

Mean Weight 0.2g.

(b) Solubilizers and dissolving method

Dimethyl sulfoxide.

Hydrogenated Castor Oil (HCO-40).

The amount of solubilizer to test sample were 22 times the quantity of dimethyl sulfoxide and 20 times of the quantity of Hydrogenated Castor Oil in weight ratio. The mixture of sample and solubilizer is irradiated with supersonic wave for 10 minutes, and dissolved in water. The concentration of the stock solution is 500ppm.

Refer to Kenji Tabata : "The proposal for standard TLm test using Orange-Red Killfish as test fish," Journal of Water and Waste, 14, 1297 - 1303 (1972)

(c) Test temperature

25 ± 2 ℃.

(d) Result

48-hours TLm value : 230ppm (w/v)

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5.2.2. Test of the degree of accumulation

(a) Disinfection

(1) The test fishes were bathed in the aqueous solution containing 30g. of $CuSO_4$ and 36ml. of acetic acid in 60 l. of water for 30 seconds, and then 10ppm solution of chlorotetracycline hydrochloride for 24 hours.

(2) Acclimation, 25 ± 2°C x 14 days.

(b) Test tank

Glass, about 100 l. in volume.

Flow rate of test water, 576 l. per day.

(c) Test fish

Carp (Cyprinus carpio).
Mean weight, 30g.
Mean length, 10cm.

(d) Solubilizer

Same to 5.2.1. (b)

(e) Test Temperature

25 ± 2°C.

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(f) Exposure level of test sample

Two exposure level's that is 1/1,000 and 1/10,000 of 48 hrs TLm value were chosen.

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Higher $230 \times \frac{1}{1,000} = 300 \times \frac{1}{1,000} = 0.3$

Lower $230 \times \frac{1}{10,000} = 300 \times \frac{1}{10,000} = 0.03$ppm

Carrier

Exposure levels	Test sample ppm	Dimethyl sulfoxide	Hydrogenated Castor Oil (HCO 40)
Higher	0.3	0.6	6.0
Lower	0.03	0.06	0.6

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Table - 1.

Mean of test sample concentration in exposure water for the calculation of the concentration factor

Exposure levels \ Week	2W	4W	6W	8W
Higher 0.3	0.282	0.268	0.270	0.276
Lower 0.03	0.0250	0.0255	0.0259	0.0260

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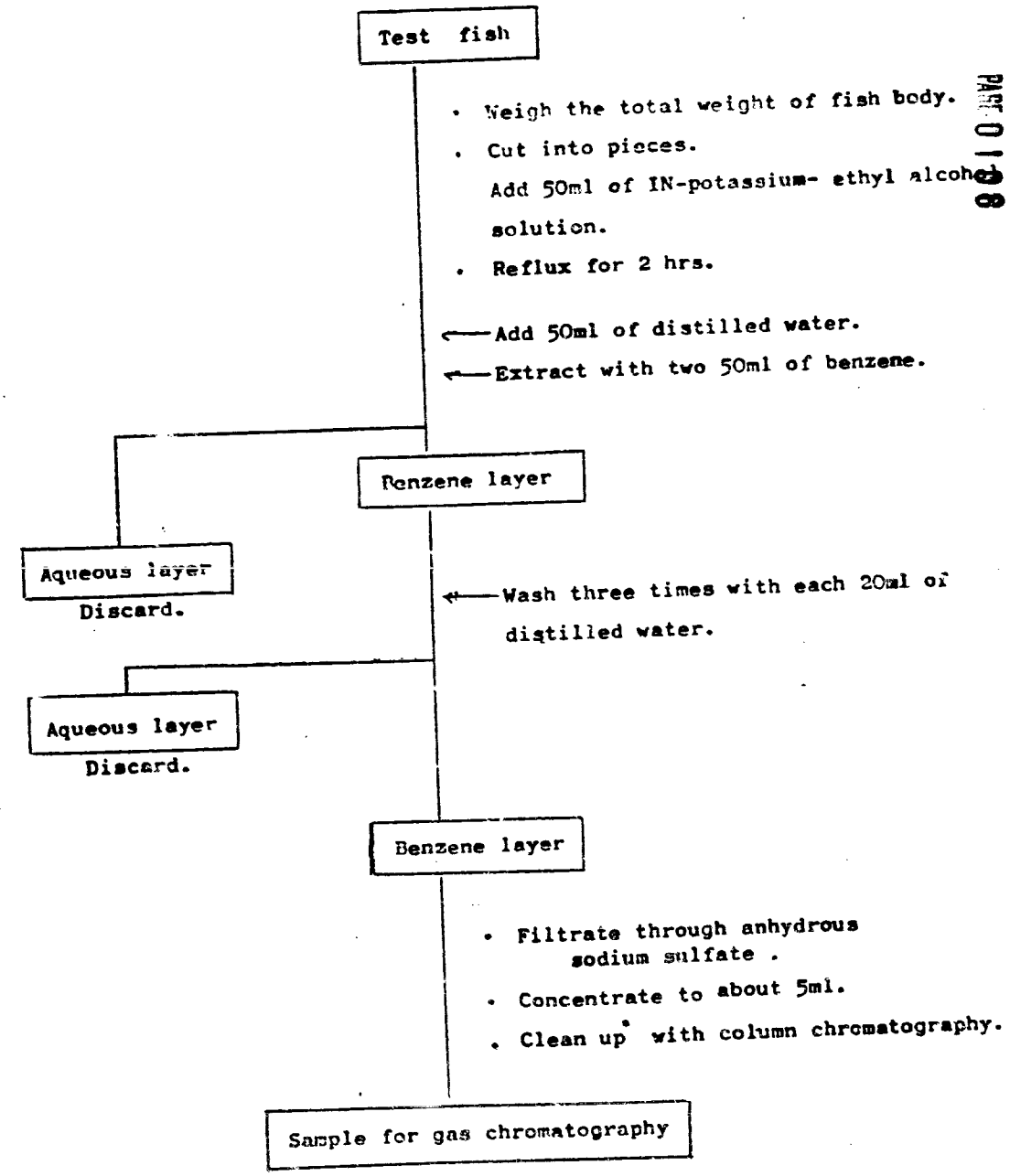
5.2.3. Analytical procedure

a) Test fish



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TAKAMATSU, KAGOSHIMA, KURUME.

* Column chromatography conditions.

(1) Adsorbent

Silica gel, washed with conc. hydrochloric acid.

(2) Conditioning

Activated at 110°C for 24 hrs.
5% of water in weight ratio was added to activated silica gel, and kept at least for 12 hrs before use.

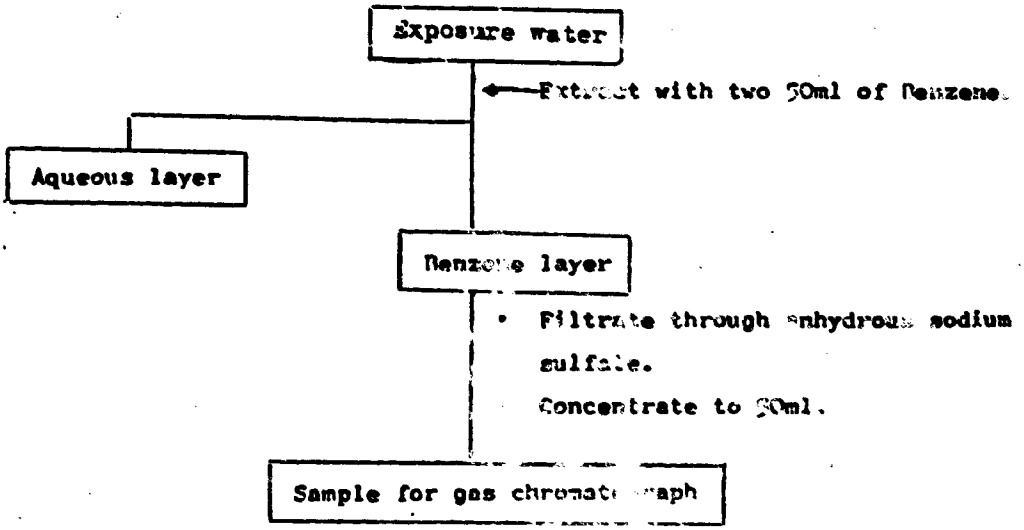
(3) Chromatographic column

Glass column, 10mm in diameter, 15g of the conditioned silica gel packed in.

(4) Eluent Benzene.

** The first 50ml of fraction was provided for gaschromatography analysis.

b) Exposure water



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5.2.4. Analytical conditions for gas chromatography

Column	:	Glass, 2mm$^{\phi}$ x 30cm
Stationary phase	:	Silicon DC200, 2%/Gas chrom Q 80/100 mesh
Column temp	:	235°C
Carrier gas	:	N_2
Detector	:	ECD (^{63}Ni)

6. Test results

Table - 2. Concentration factor

Exposure levels \ Week	2W	4W	6W	8W
Higher 0.5	56.6 26.6	10.3 27.9	5.7 5.2	8.6 27.1
Lower 0.3	19.0 19.7	11.9 37.4	26.1 29.2	43.6 25.4

Last Item

Chemical Biotesting Center

Chemicals Inspection & Testing Institute, Japan
4-1-1, Higashi-mukojima, Sumidaku,
Tokyo, Japan
Director, Toshiro Arai

Toshiro. Hirai

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Table - 3 Results of fish analysis

Figs. No	Samples	A Injection volume (μl)	B Peak height (mm)	C B/μl	D Sample conc. (ppm)	E Dilution ratio
	(Upper exposure level)					
4	Standard solution	4	101		0.2	
"	Recovery- a	4	67		0.133	20
"	Standard solution	4	93		0.2	
"	Recovery- b	4	62		0.133	20
	(Lower exposure level)					
"	Standard solution	4	91		0.2	
"	Recovery- a	4	62		0.136	1
"	Standard solution	4	87		0.2	
"	Recovery- b	4	65		0.149	1
	(Blank test)					
"	Standard solution	4	103		0.2	
"	Blank- a	4	n.d		—	
"	Standard solution	4	102		0.2	
"	Blank- b	4	n.d		—	
"	Reagent blank	4	n.d		—	
"	Standard solution	4	92		0.2	
"	Blank- a	4	n.d		—	
"	Standard solution	4	100		0.2	
"	Blank- b	4	n.d		—	

0 0 8 1

	E	F	G	H	I	Sample size added to fish	
conc.	Dilution ratio	Filled up volume (ml)	Sample weight (µg)	Fish weight (g)	Correction factor (%) (Recovery)	M	N
						Conc. (ppm)	Volume (ml)
0.2							
0.133	20	50	133	29.2	88.4	100	1.5
0.2							
0.133	20	50	133	29.5	88.9	100	1.5
					(88.7)		
0.2							
0.136	1	50	6.81	29.8	68.1	10	1
0.2							
0.149	1	50	7.47	29.5	74.7	10	1
					(71.4)		
0.2							
—			—	24.6			
0.2							
—			—	26.3			
—							
0.2							
—			—	31.6			
0.2							
—			—	39.3			

MF0112

Table - 9 Results of fish analysis

Figs. No	Samples	A Injection volume (μℓ)	B Peak height (mm)	C B/μℓ	D Sample conc. (ppm)	E Dilution ratio
5	Standard solution	4	114		0.2	
"	2 w - a	4	82		0.144	50
"	Standard solution	4	95		0.2	
"	2 w - b	4	33		0.070	50
"	Standard solution	4	113		0.2	
"	4 w - a	4	34		0.060	25
"	Standard solution	4	108		0.2	
"	4 w - b	4	87		0.161	25
"	Standard solution	4	106		0.2	
"	6 w - a	4	95		0.179	5
"	Standard solution	4	94		0.2	
"	6 w - b	4	78		0.166	5
"	Standard solution	4	96		0.2	
"	8 w - a	4	52		0.108	10
"	Standard solution	4	99		0.2	
"	8 w - b	4	75		0.152	25

0 0 8 3

Upper exposure level 0.3ppm

F	G	H	I	J	K	L
Filled up volume (ml)	Sample weight (µg)	Fish weight (g)	Correction factor (%) (recovery)	Sample conc. in fish (ppm)	Sample conc. in exposure water (ppm)	Concentration factor
50	360	25.4	88.7	16.0	0.282	5[illegible]
						[illegible]
50	174	26.1	88.7	7.50	0.282	26[illegible]
50	75.2	30.7	88.7	2.76	0.268	10.3
50	201	30.4	88.7	7.47	0.268	27.9
50	44.8	27.8	88.7	1.82	0.270	6.7
50	41.5	33.1	88.7	1.41	0.270	5.2
50	54.2	25.7	88.7	2.38	0.276	8.6
50	189	28.5	88.7	7.49	0.276	27.1

0 0 8 4

Table - 5 Results of fish analysis

Figs. No	Samples	A Injection volume (μℓ)	B Peak height (mm)	C B/A	D Sample conc. (ppm)	E Dilution ratio
6	Standard solution	4	107		0.2	
"	2 w - a	4	104		0.194	
"	Standard solution	4	96		0.2	
"	2 w - b	4	83		0.173	1
"	Standard solution	4	106		0.2	
"	4 w - a	4	63		0.119	1
"	Standard solution	4	106		0.2	
"	4 w - b	4	105		0.198	2
"	Standard solution	4	101		0.2	
"	6 w - a	4	72		0.143	2
"	Standard solution	4	117		0.2	
"	6 w - b	4	86		0.147	2
"	Standard solution	4	92		0.2	
"	8 w - a	4	61		0.133	4
"	Standard solution	4	98		0.2	
"	8 w - b	4	81		0.165	2

0085

Lower exposure level 0.03 ppm

F	G	H	I	J	K	L
Filled up volume (ml)	Sample weight (μg)	Fish weight (g)	Correction factor (%) (recovery)	Sample conc. in fish (ppm)	Sample conc. in exposure water (ppm)	Concentration factor
50	9.72	28.7	71.4	0.474	0.0250	[illegible]
50	8.64	24.6	71.4	0.492	0.0250	[illegible]
50	5.94	27.4	71.4	0.304	0.0255	11.9
50	19.8	29.1	71.4	0.954	0.0255	37.4
50	14.3	29.5	71.4	0.677	0.0259	26.1
50	14.7	27.2	71.4	0.757	0.0259	29.2
50	26.5	32.8	71.4	1.13	0.0260	43.[illegible]
50	16.5	35.0	71.4	0.661	0.[illegible]0	25.4

Table - 6 Calculation procedure

$$\text{Concentration factor(L)} = \frac{P \times B(f) \times A(Std) \times E \times F}{A(f) \times B(Std)} - Bl \times \frac{100}{H \times I \times K}$$

$$\text{Sample weight in fish(G)} = \frac{P \times B(f) \times A(Std) \times E \times F}{A(f) \times B(Std)} - Bl$$

$$\text{Sample conc. in fish(J) (ppm)} = G \times \frac{100}{H \times I}$$

$$\text{Recovery(I) (\%)} = \frac{P \times B(f) \times A(Std) \times E \times F \times 100}{A(f) \times B(Std) \times M \times N}$$

P : Standard solution conc. (ppm)

A(Std) : Injection volume of standard solution (μl)

B(Std) : Peak height of standard solution (mm)

A(f) : Injection volume of sample

B(f) : Peak height of sample (mm)

E : Dilution ratio

F : Filled up volume (ml)

H : Fish weight (g)

I : Correction factor (Recovery) (%)

M : Conc. of standard sample added to fish for recovery test. (ppm)

N : Volume of standard sample added to fish for recovery test. (ml)

K : Sample conc. in exposure water (ppm)

Bl : Arithmetical mean of sample weight in the fish at the (μg) start of, and at the temination of the blank test.

Table -7 Results of exposure water analysis

Figs. No	Samples	A	B	C	D	E
		Injection volume (μl)	Peak height (m.m)	F/μl	Sample conc. (ppm)	Dilution ratio
8	(Upper exposure level)					
"	Standard solution	4	98		0.2	
"	Recovery-a	4	107		0.218	1
"	Standard solution	4	98		0.2	
"	Recovery-b	4	117		0.239	1
	(Lower exposure level)					
"	Standard solution	4	98		0.2	
"	Recovery-a	4	127		0.259	1
"	Standard solution	4	98		0.2	
"	Recovery-b	4	118		0.241	1
	(Blank test)					
"	Standard solution	4	99		0.2	
"	Blank-a	4	n.d			
"	Standard solution	4	99		0.2	
"	Blank-b	4	n.d			

E	F	G	H	I	Sample size added to water for recovery test	
Dilution ratio	Filled up volume (ml)	Sample weight (g)	Volume of water Taken (ml)	Correction factor (%) (Recovery)	K Conc. (ppm)	L Volume (ml)
1	50	10.9	50	72.8	5	3
1	50	11.9	50	79.6	5	3
				(76.2)		
1	50	13.0	50	86.4	5	3
1	50	12.0	50	80.3	5	3
				(83.4)		

0 0 8 9

Table - 8 -1 Results of exposure water analysis

Figs. No	Samples	A	B	C	D	E
		Injection volume (μl)	Peak height (mm)	B/μl	Sample conc. (ppm)	Dilution ratio
9	Standard solution	4	90		0.2	
"	After 2 days	4	97		0.216	1
"	Standard solution	4	91		0.2	
"	After 6 days	4	93		0.204	1
"	Standard solution	4	88		0.2	
"	After 9 days	4	92		0.209	1
"	Standard solution	4	90		0.2	
"	After 13 days	4	104		0.231	1
10	Standard solution	4	90		0.2	
"	After 17 days	4	95		0.211	1
"	Standard solution	4	96		0.2	
"	After 20 days	4	100		0.208	1
"	Standard solution	4	101		0.2	
"	After 23 days	4	94		0.186	1
"	Standard solution	4	98		0.2	
"	After 27 days	4	84		0.171	1

Upper exposure level 0.3 ppm

E	F	G	H	I	J	M
Dilution ratio	Filled up volume (ml)	Sample weight (μg)	Volume of water taken (ml)	Correction factor (Recovery)	Sample conc. in exposure water (ppm)	Average of conc. (ppm)
1	50	10.8	50	0.762	0.283	
1	50	10.2	50	0.762	0.268	
1	50	10.5	50	0.762	[illegible]	
1	50	11.6	50	0.762	0.303	
						0.28[illegible]
1	50	10.6	50	0.762	0.277	
1	50	10.4	50	0.762	0.273	
1	50	9.31	50	0.762	0.244	
1	50	8.57	50	0.762	0.225	
						0.268

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0091

Table - 8 -2 Results of exposure water analysis

Figs. No	Samples	A. Injection volume (μl)	B Peak height (mm)	C B/μl	D Sample conc. (ppm)	E Dilution ratio
11	Standard solution	4	96		0.2	
〃	After 34 days	4	102		0.212	
〃	Standard solution	4	105		0.2	
〃	After 41 days	4	111		0.211	1
〃	Standard solution	4	103		0.2	
〃	After 48 days	4	118		0.229	1
〃	Standard solution	4	96		0.2	
〃	After 56 days	4	112		0.233	1

MAT 0122

E	F	G	H	I		K
Dilution ratio	Filled up volume (ml)	Sample weight (μg)	Volume of water taken (ml)	Correction factor (Recovery)	Sample conc. in exposure water (ppm)	Average of conc. (ppm)
1	50	10.6	50	0.762	0.279	
1	50	10.6	50	0.762	0.277	
						0.270
1	50	11.5	50	0.762	0.301	
1	50	11.7	50	0.762	0.306	
						0.276

0 0 4 3

Table - 9 -1 Results of exposure water analysis

Figs. No	Samples	A Injection volume (μl)	B Peak height (mm)	C B/μl	D Sample conc. (ppm)	E Dilution ratio
9	Standard solution	4	90		0.2	
〃	After 2 days	4	92		0.204	1
〃	Standard solution	4	91		0.2	
〃	After 6 days	4	98		0.215	1
〃	Standard solution	4	88		0.2	
〃	After 9 days	4	84		0.190	1
〃	Standard solution	4	90		0.2	
〃	After 13 days	4	101		0.224	1
1[illegible]	Standard solution	4	90		0.2	
[illegible]	After 17 days	4	101		0.224	1
〃	Standard solution	4	96		0.2	
	After 20 days	4	113		0.235	1
	Standard solution	4	101		0.2	
〃	After 23 days	4	91		0.180	1
〃	Standard solution	4	98		0.2	
	After 27 days	4	112		0.229	1

Lower exposure level 0.02ppm

E (tion ratio	F Filled up volume (ml)	G Sample weight (μg)	H Volume of water taken (ml)	I Correction factor (Recovery)	J Sample conc. in exposure water (ppm)	M Average of conc. (ppm)
1	50	10.2	500	0.834	0.0245	
1	50	10.8	500	0.834	0.0258	
1	50	9.54	500	0.834	0.0229	
1	50	11.2	500	0.834	0.0269	
						0.0250
1	50	11.2	500	0.834	0.0269	
1	50	11.7	500	0.834	0.0282	
1	50	9.01	500	0.834	0.0216	
1	50	11.4	500	0.0834	0.0274	
						0.0255

0 0 9 5

Table - 9 -2 Results of exposure water analysis

Figs. No	Samples	A	B	C	D	E
		Injection volume (μℓ)	Peak height (mm)	B/A	Sample conc. (ppm)	Dilution ratio
11	Standard solution	4	96		0.2	
〃	After 34 days	4	116		0.242	1
〃	Standard solution	4	105		0.2	
〃	After 41 days	4	112		0.213	1
〃	Standard solution	4	103		0.2	
〃	After 48 days	4	108		0.210	1
〃	Standard solution	4	96		0.2	
〃	After 56 days	4	112		0.233	1

Lower exposure level

E	F	G	H	I	J	M
Dilution ratio	Filled up volume (ml)	Sample weight (μg)	Volume of water taken (ml)	Correction factor (Recovery)	Sample conc. in exposure water (ppm)	Average of conc. (ppm)
1	50	12.1	500	0.834	0.0290	
1	50	10.7	500	0.834	0.0256	
						0.0259
1	50	10.5	500	0.834	0.0251	
1	50	11.7	500	0.834	0.0280	
						0.0260

0 0 9 7

Table - 10 Calculation procedure

$$\text{Sample conc. in water (J) (ppm)} = \frac{P \times B(f) \times A(Std) \times E \times F}{A(f) \times B(Std) \times H \times I}$$

$$\text{Sample weight in water (G)} = \frac{P \times B(f) \times A(Std) \times E \times F}{A(f) \times B(Std)}$$

$$\text{Recovery (I) (\%)} = \frac{P \times B(f) \times A(Std) \times E \times F \times 100}{A(f) \times B(Std) \times K \times L}$$

$$\text{Average of conc. (M)} = \frac{\text{Sample conc. (2 days)} + \cdots + \text{Sample conc. (n'th days)}}{N}$$

N : Number of measurements

P : Standard solution conc. (ppm)

A(Std) : Injection volume of standard solution ($\mu\ell$)

B(Std) : Peak height of standard solution (mm)

A(f) : Injection volume of sample ($\mu\ell$)

B(f) : Peak height of sample (mm)

E : Dilution ratio

F: Filled up volume (ml)

H : Volume of water taken (ml)

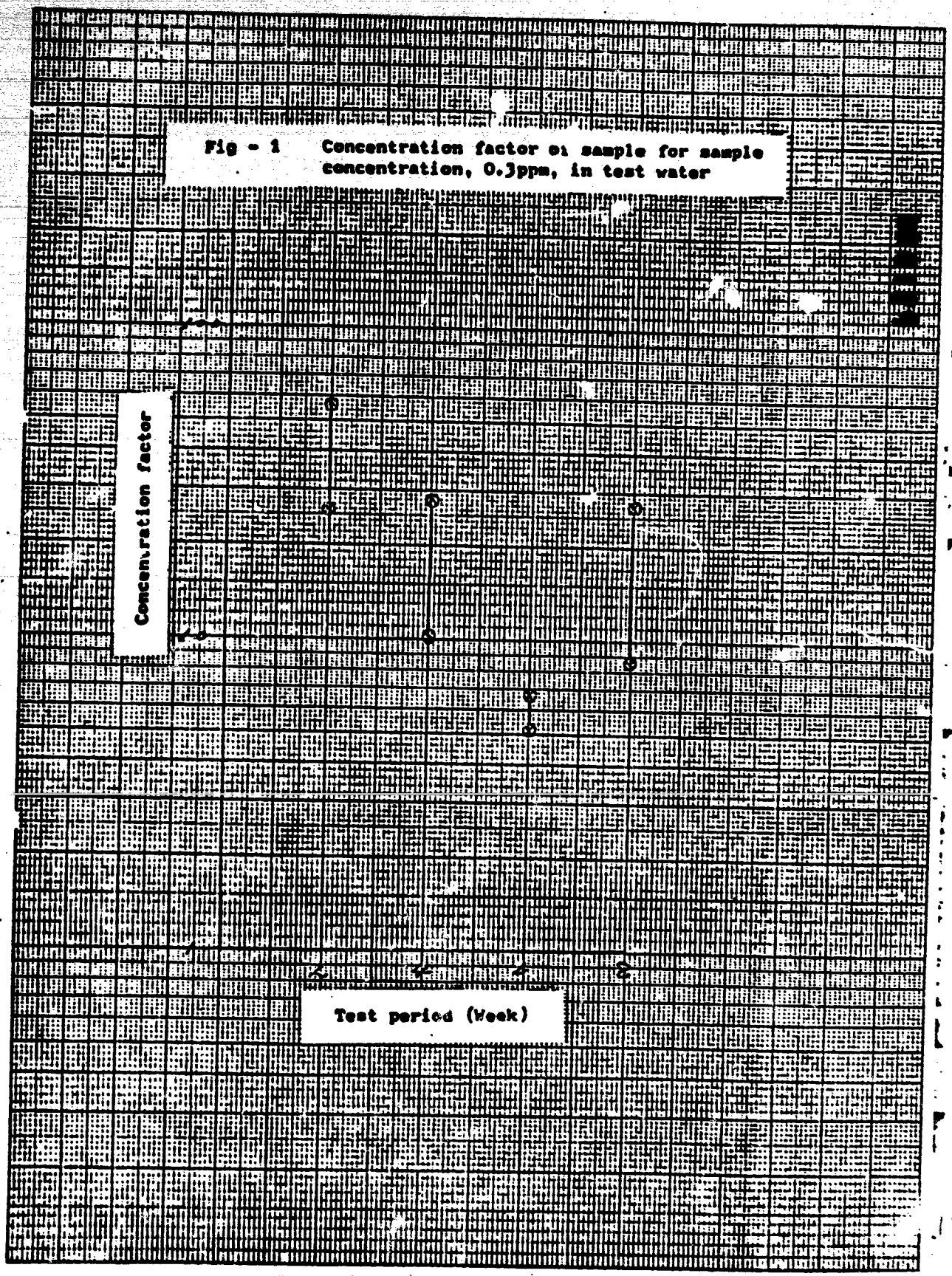
I : Correction factor (Recovery) (%)

K : Conc. of standard sample added to water (ppm)

L : Volume of standard sample added to water (ml)

MSF 0120

Fig - 1 Concentration factor of sample for sample concentration, 0.3ppm, in test water



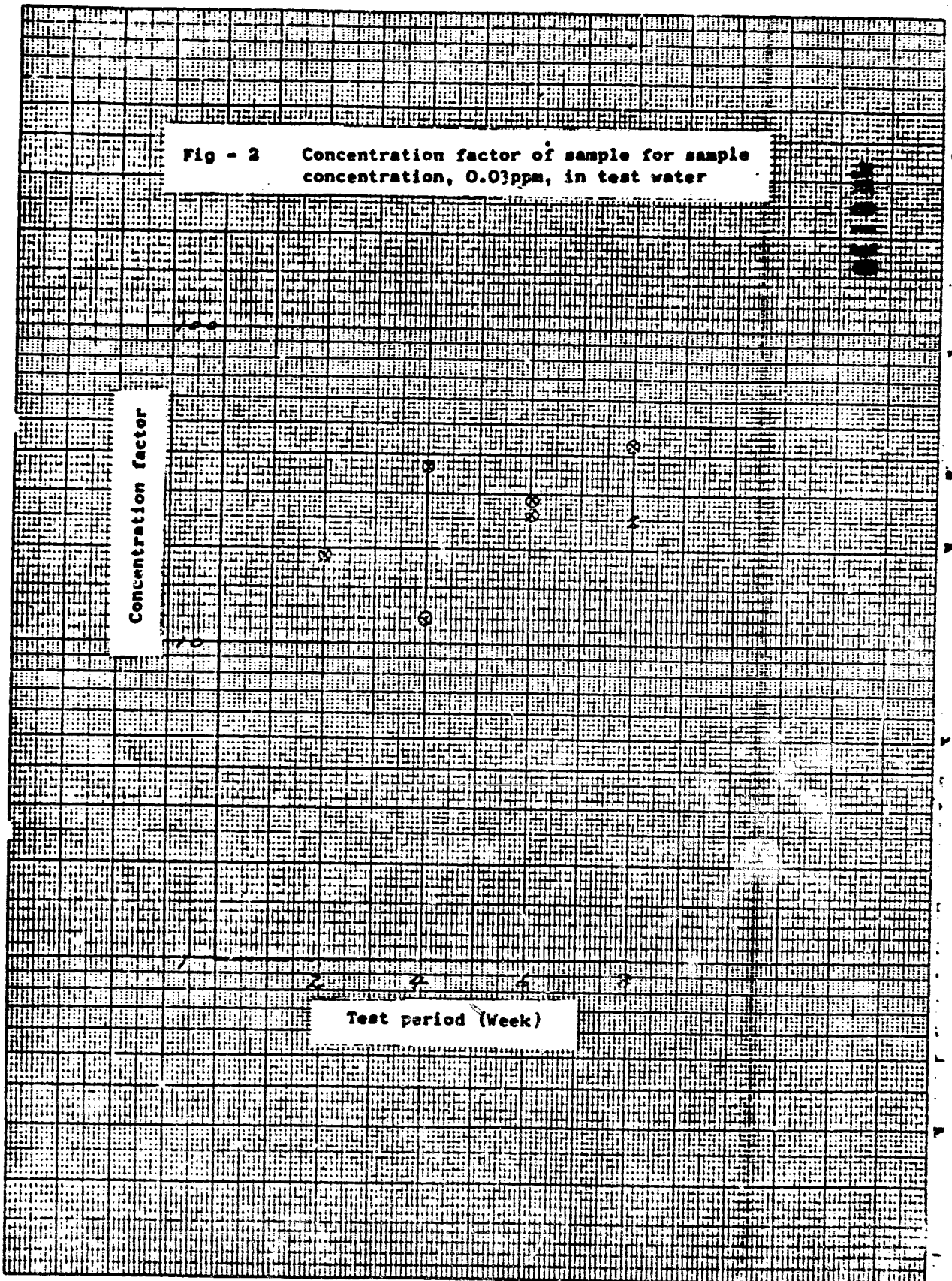


Fig - 2 Concentration factor of sample for sample concentration, 0.03ppm, in test water

Fig -3

Analysis for calibration

No

Date 16. AUG 1976

Room Temp 25 ℃

Model JGC - 20K

Sample S - 82

G(L)S 4 ml(µl) mg.

Solvent Benzene

Column L. 0.3 m. I.D. 2 mm.

Temp. 215 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV)V

Sensitivity Ni x 8

Detector Temp. 320 ℃

Injection Temp. 320 ℃

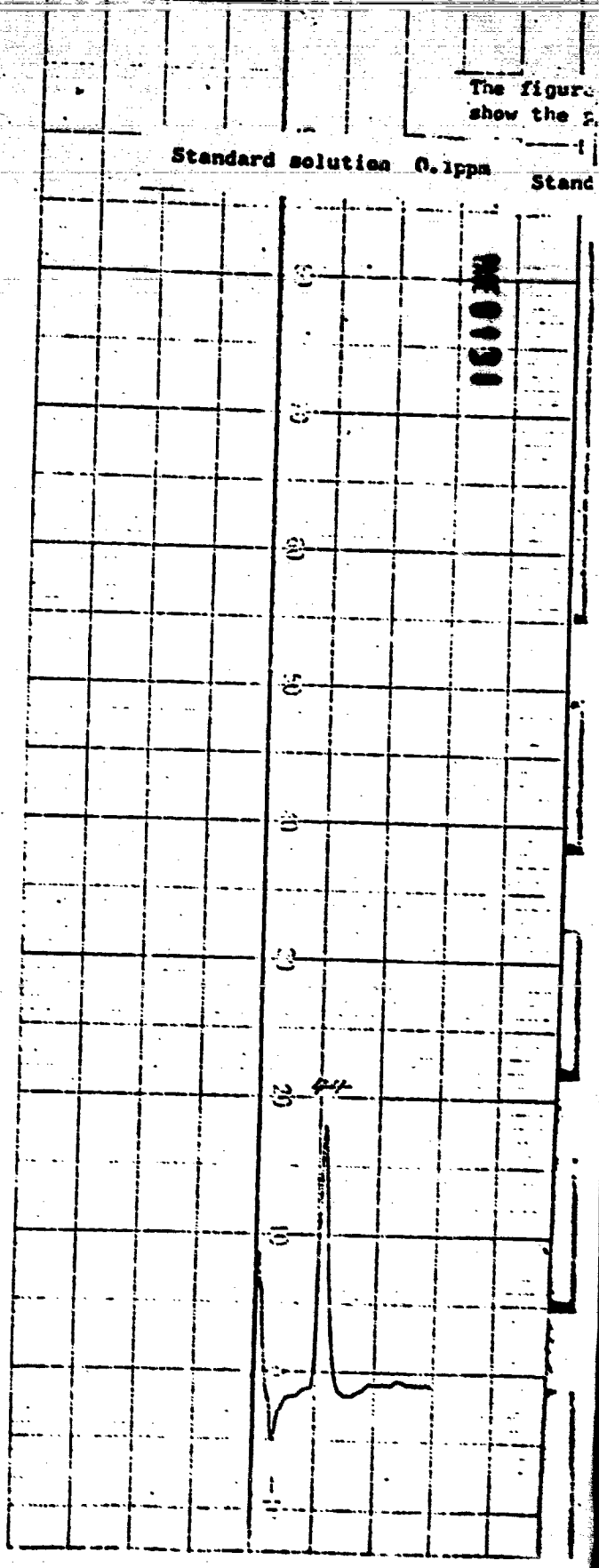
Chart Speed 5 mm/min.

Note :

Operator A Group

The figur... show the ...

Standard solution 0.1ppm Stand...

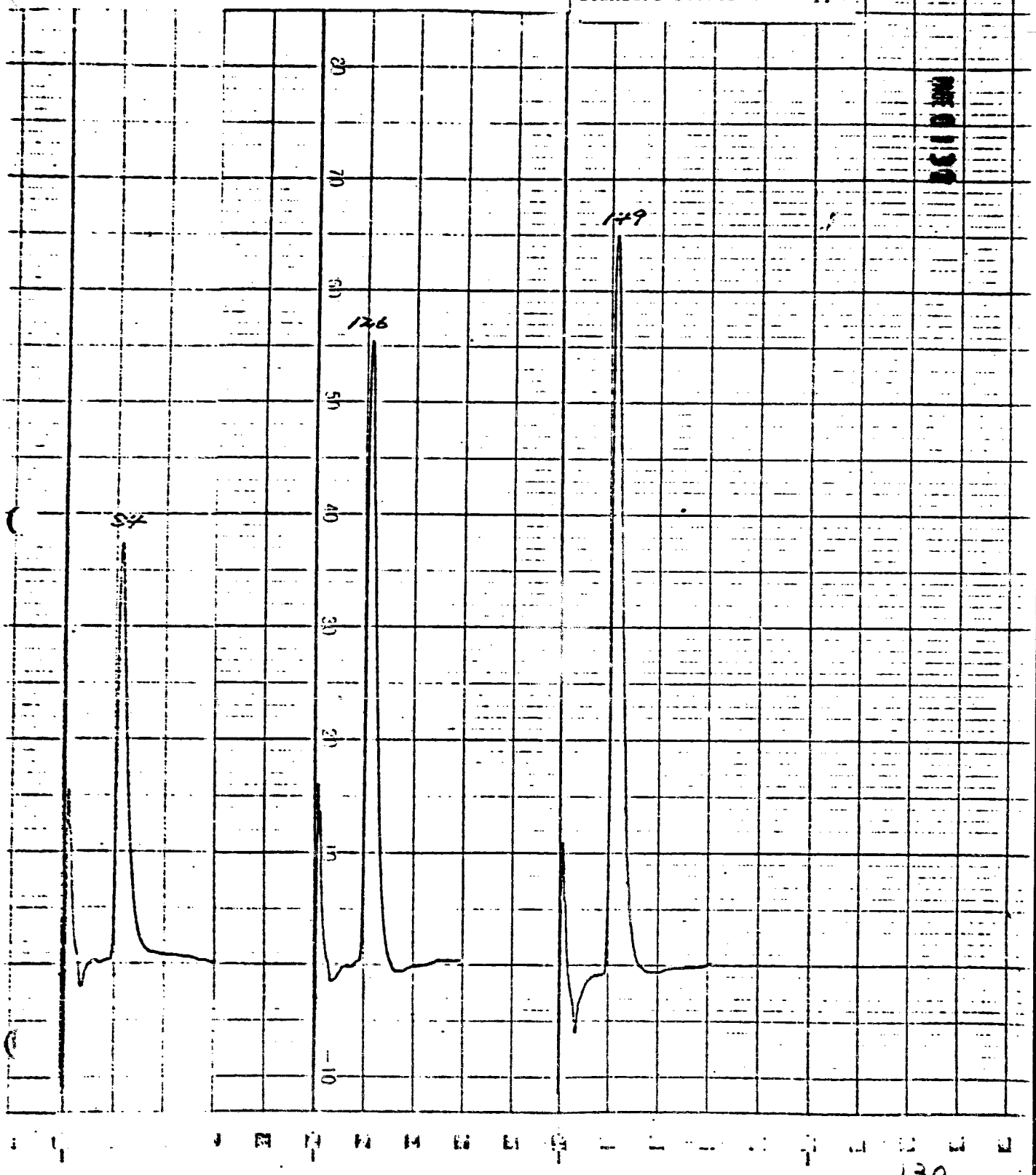


129

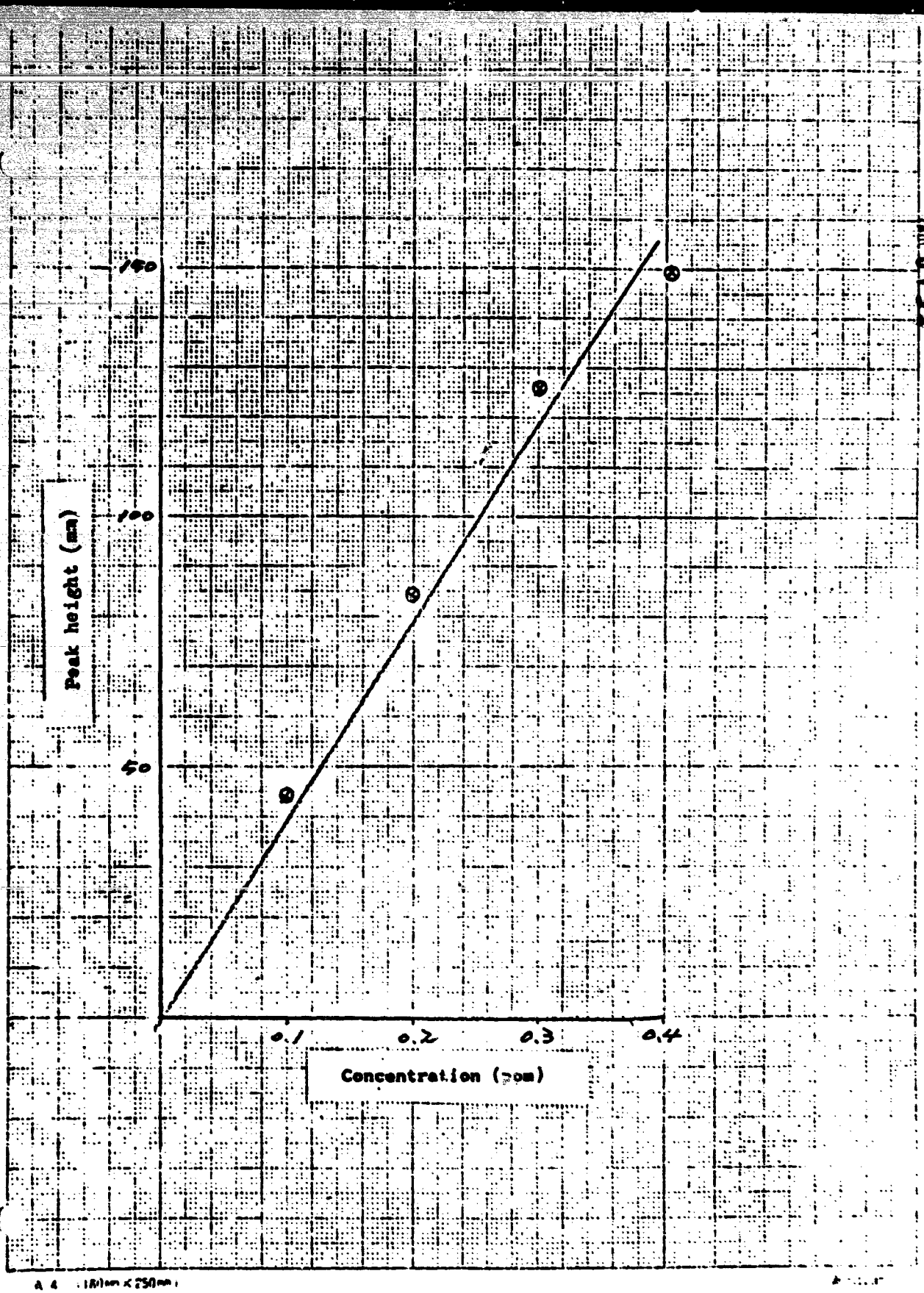
...nicals Inspection & Testing Institute, Japan

e figures above each peak
ow the peak height (mm)

tandard solution 0.2ppm Standard solution 0.3ppm Standard solution 0.4ppm



130



A 4 (180mm × 250mm)

Fig - 4 Blank test

No Recovery

Date 25 OCT 1976

Room Temp 25 ℃

Model JGC - 20K

Sample S - 82

GLS 4 ml(μl) mg.

Solvent Benzene

Column L 0.3 m. I.D. 3 mm.

Temp 235 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV)V

Sensitivity Hi x 8

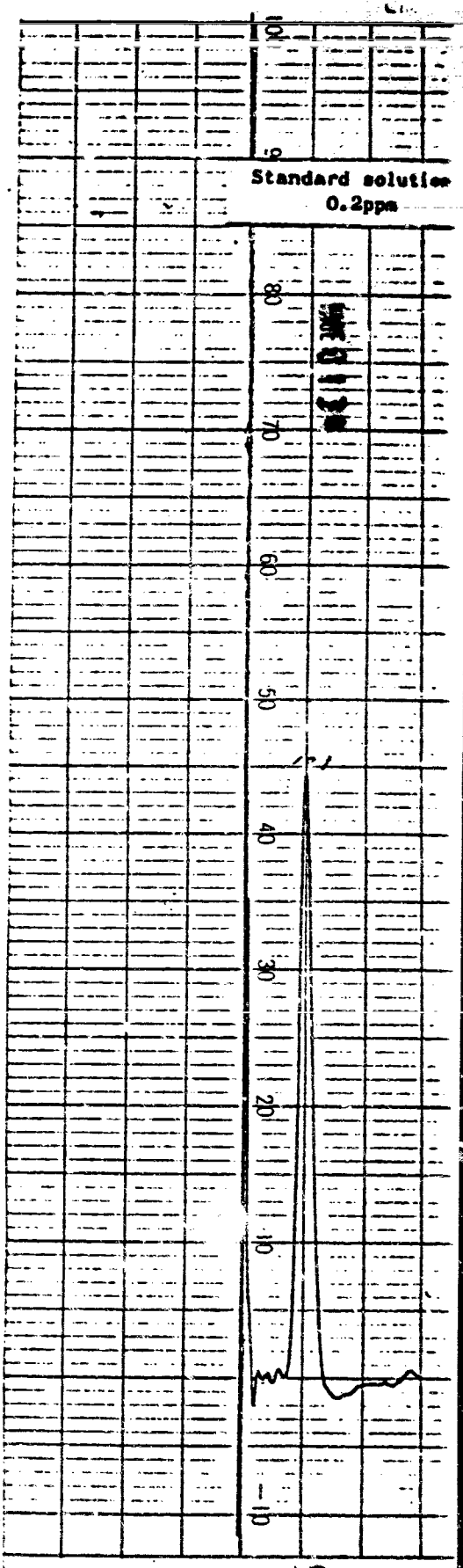
Detector Temp. 320 ℃

Injection Temp. 320 ℃

Chart Speed 5 mm/min.

Note :

Operator A Group



Chemicals Inspection & Testing Institute, Japan
Chemical Biotesting Center

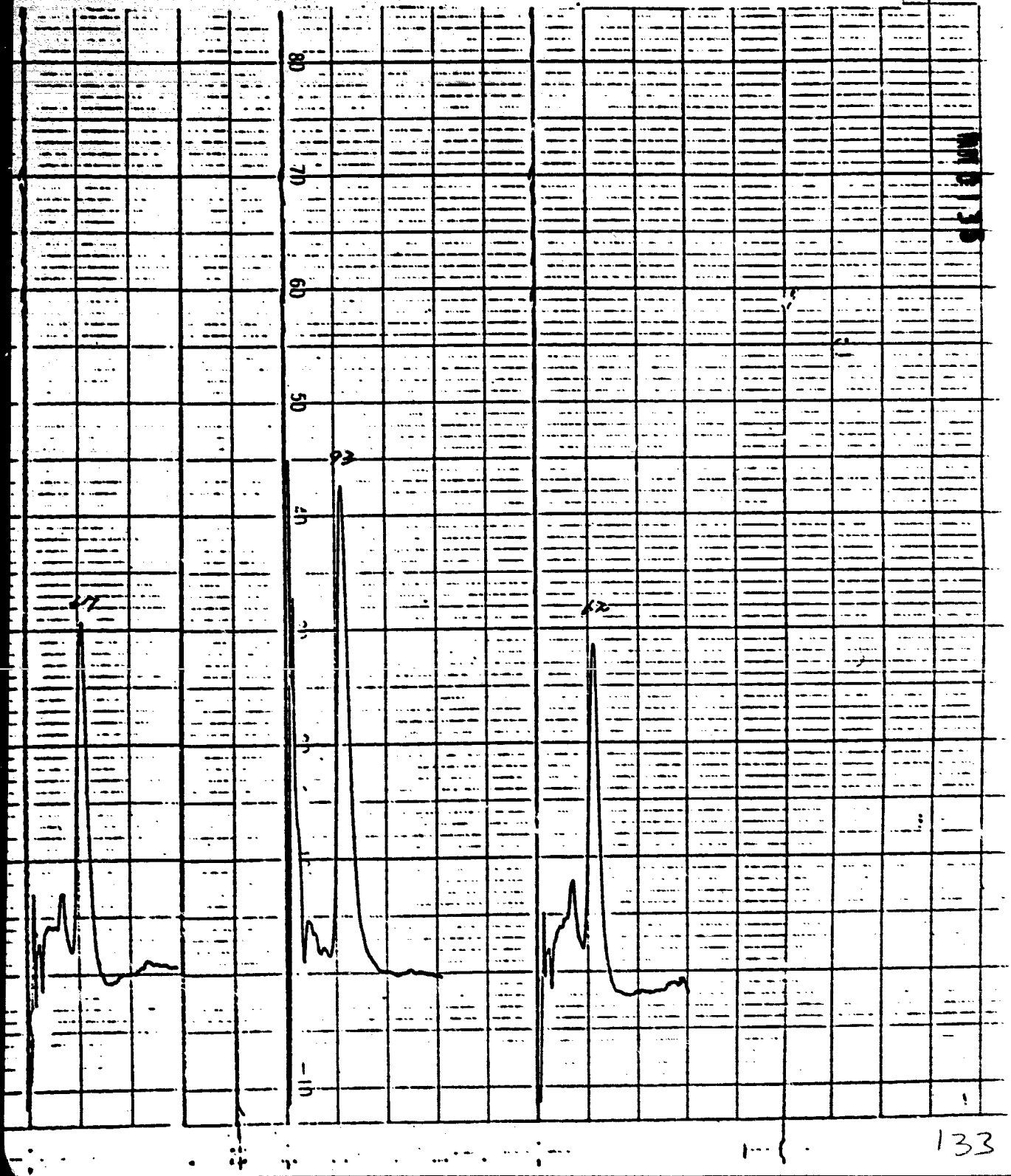
0 1 0 4

CHART NO. JK-2531

Chemical Biotesting Center

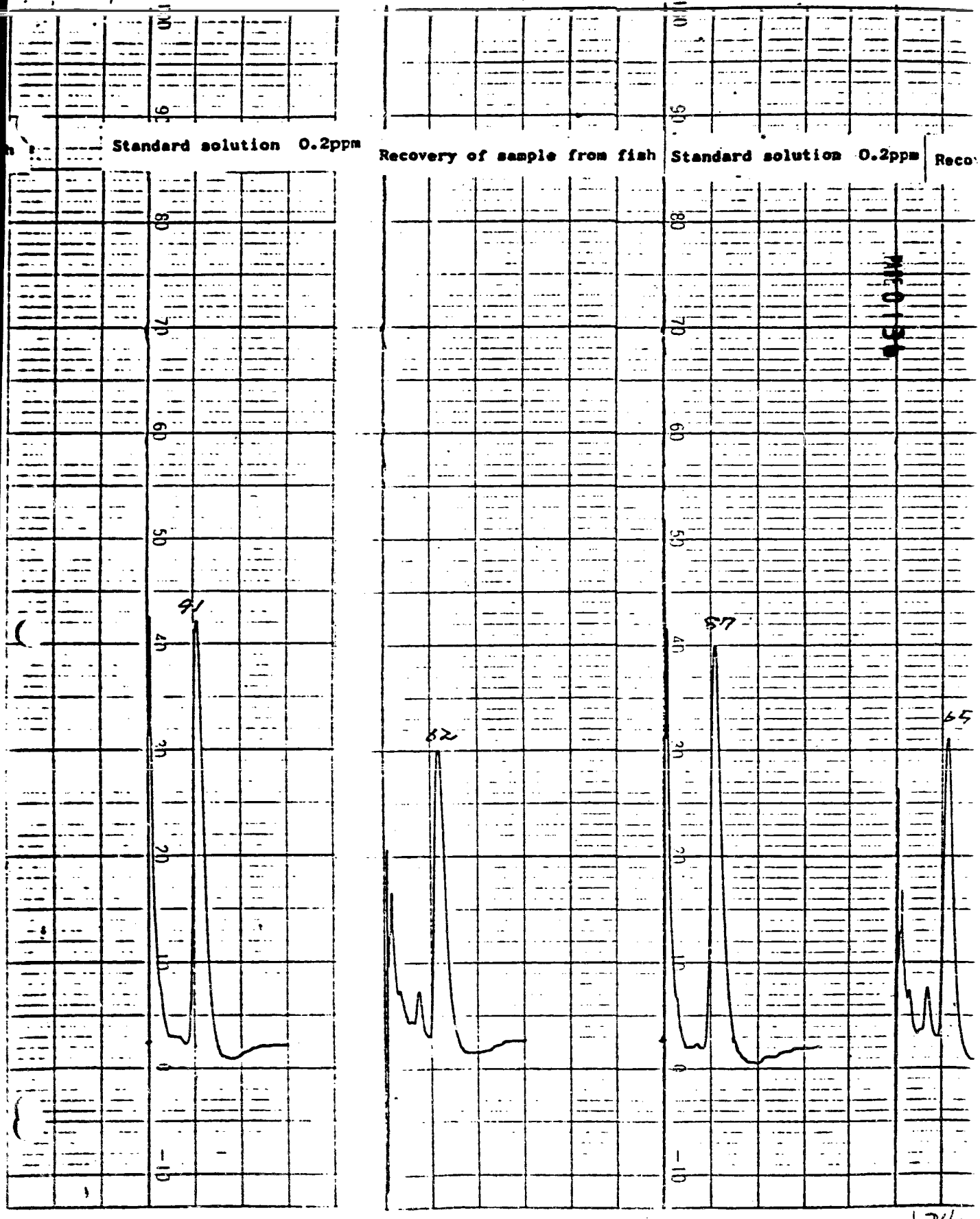
The figeures above each peak show the peak height (mm)

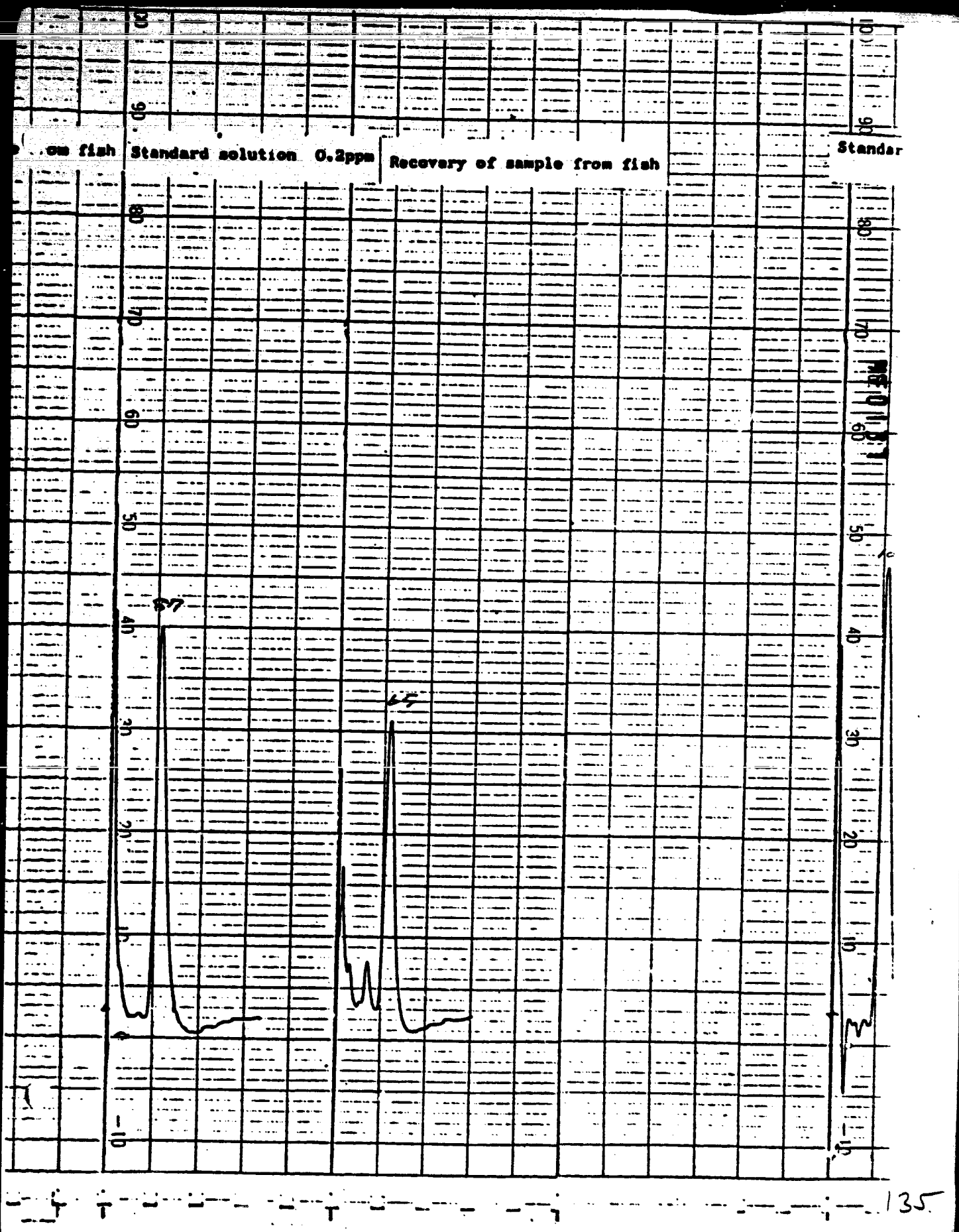
Recovery of sample from fish Standard solution 0.2ppm | Recovery of sample from fish

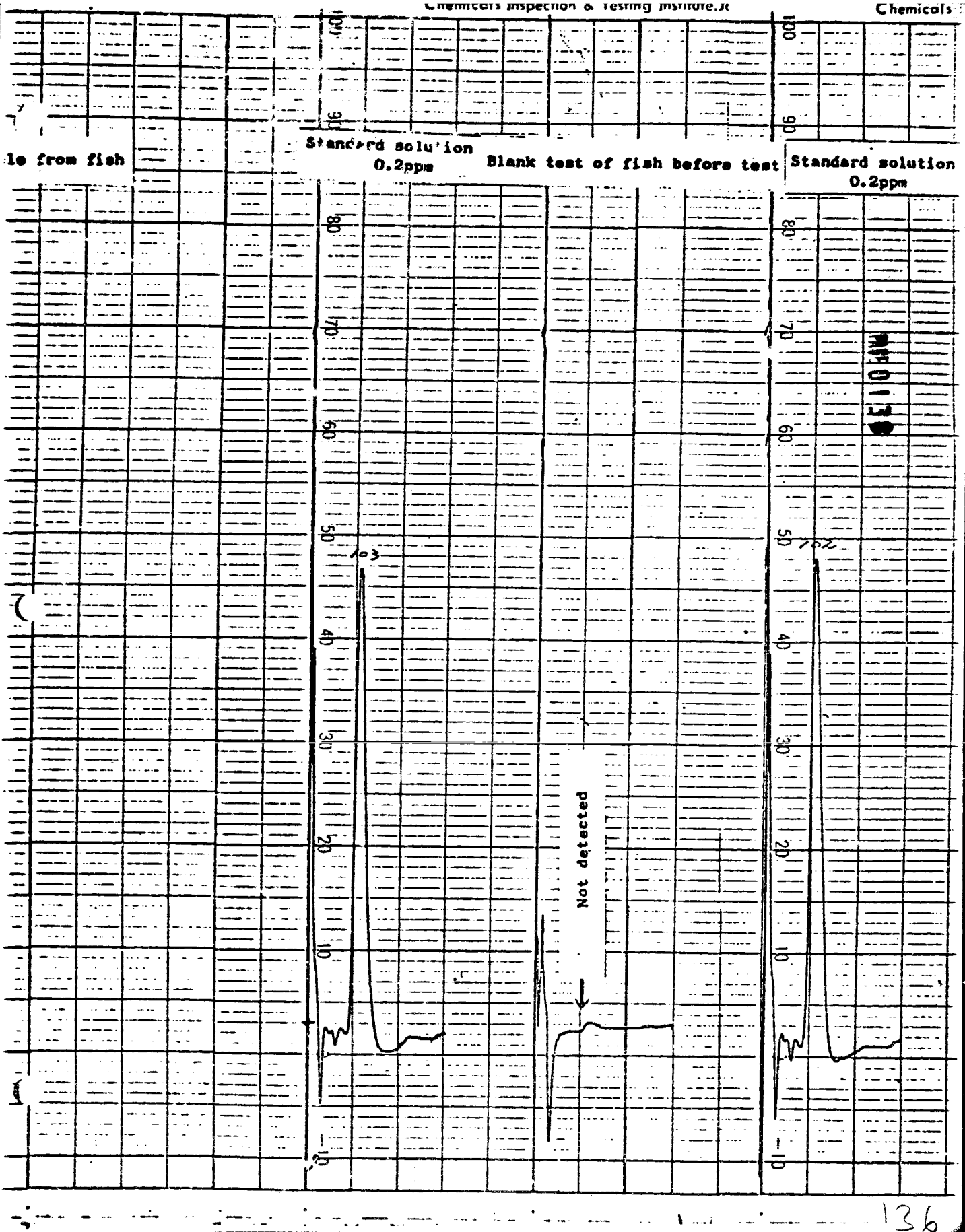


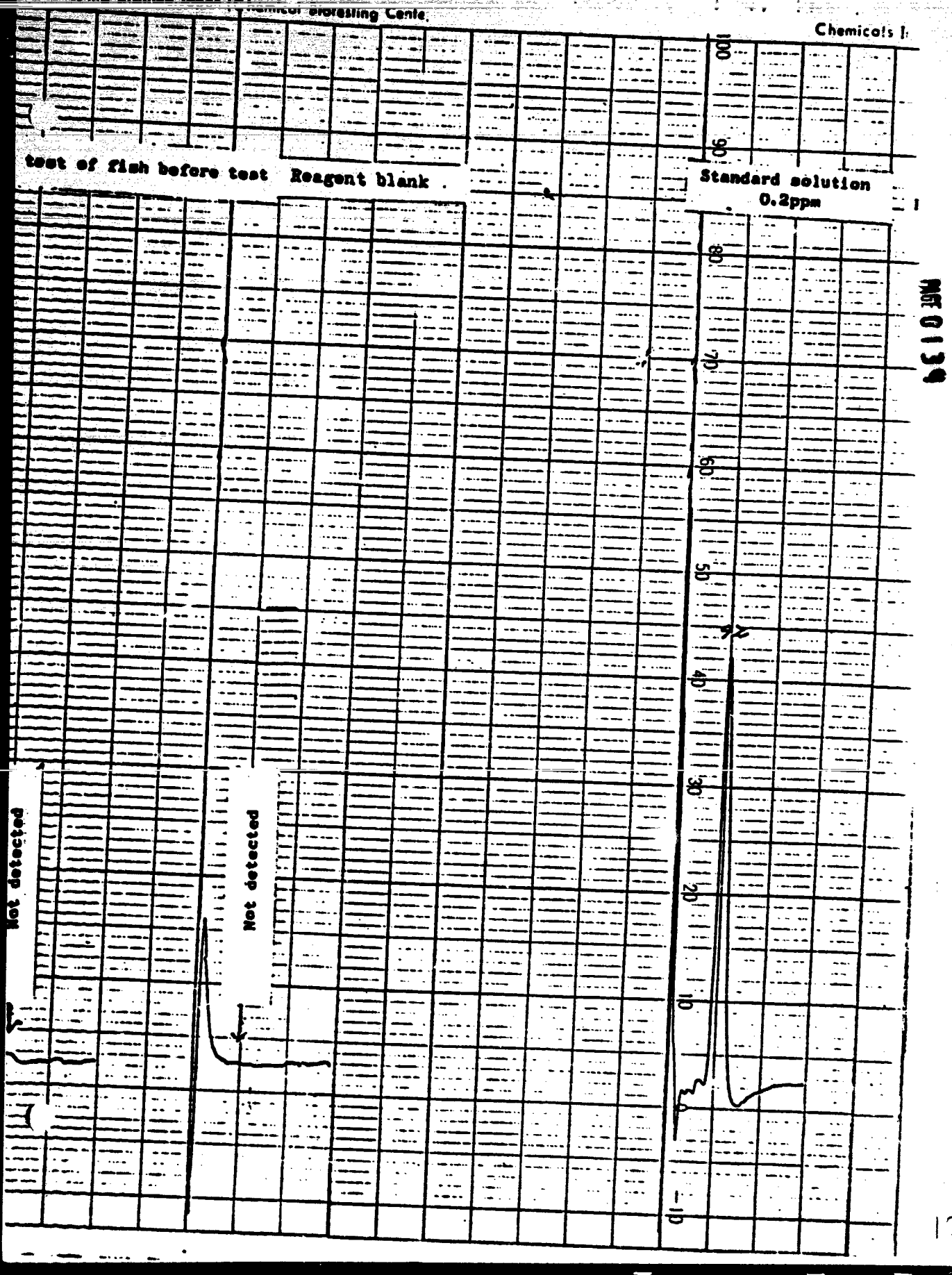
133

0105


Standard solution 0.2ppm
Recovery of sample from fish
Standard solution 0.2ppm
Reco
91
82
87
65


..ow fish Standard solution 0.2ppm
Recovery of sample from fish
Standar
87
65
135


Chemicals Inspection & Testing Institute,Jt
Chemicals
le from fish
Standard solution
0.2ppm
Blank test of fish before test
Standard solution
0.2ppm
Not detected



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137

0 1 0 4

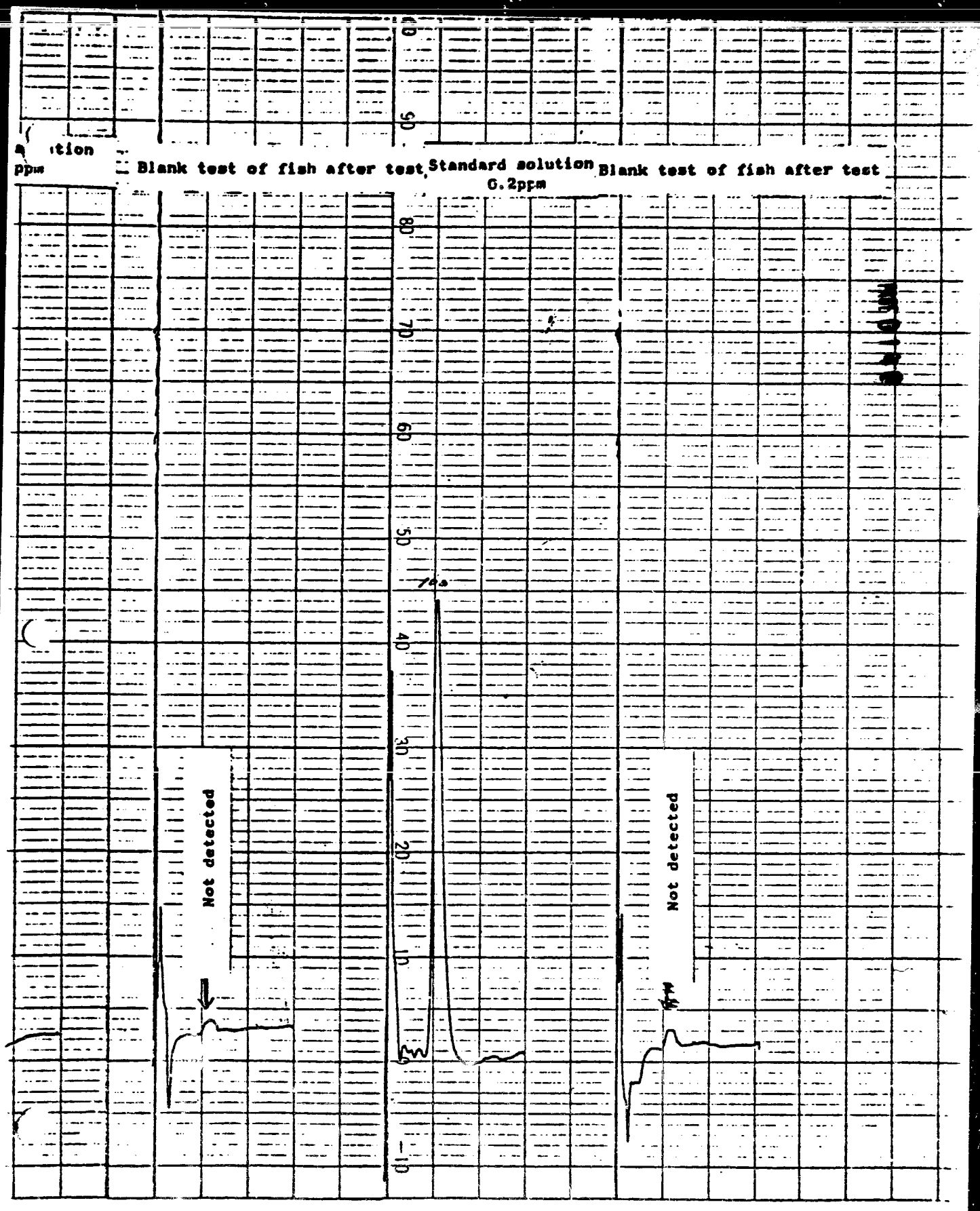

tion
ppm
Blank test of fish after test
Standard solution
0.2ppm
Blank test of fish after test
90
80
70
60
50
40
30
20
10
Not detected
Not detected

Fig - 5

No Fish 1

Date (31. AUG.) (12. OCT.) 1976
(14. SEP.)

Room Temp. 25 ℃

Model JGC - 20K

Sample S - 82

G (L) S. 4 ml (g) mg.

Solvent Benzene

Column L. 0.1 m. I.D. 3 mm.

Temp. 215 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV) V

Sensitivity Hi x 8

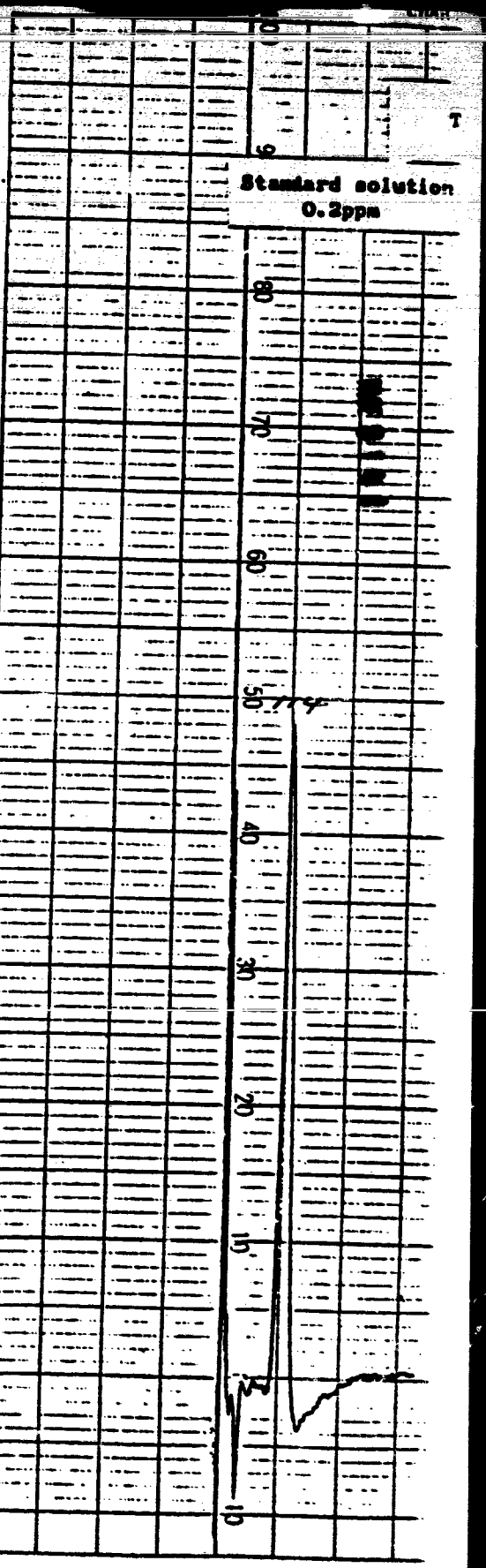
Detector Temp. 320 ℃

Injection Temp. 320 ℃

Chart Speed 5 mm/min.

Note :

Operator A Group



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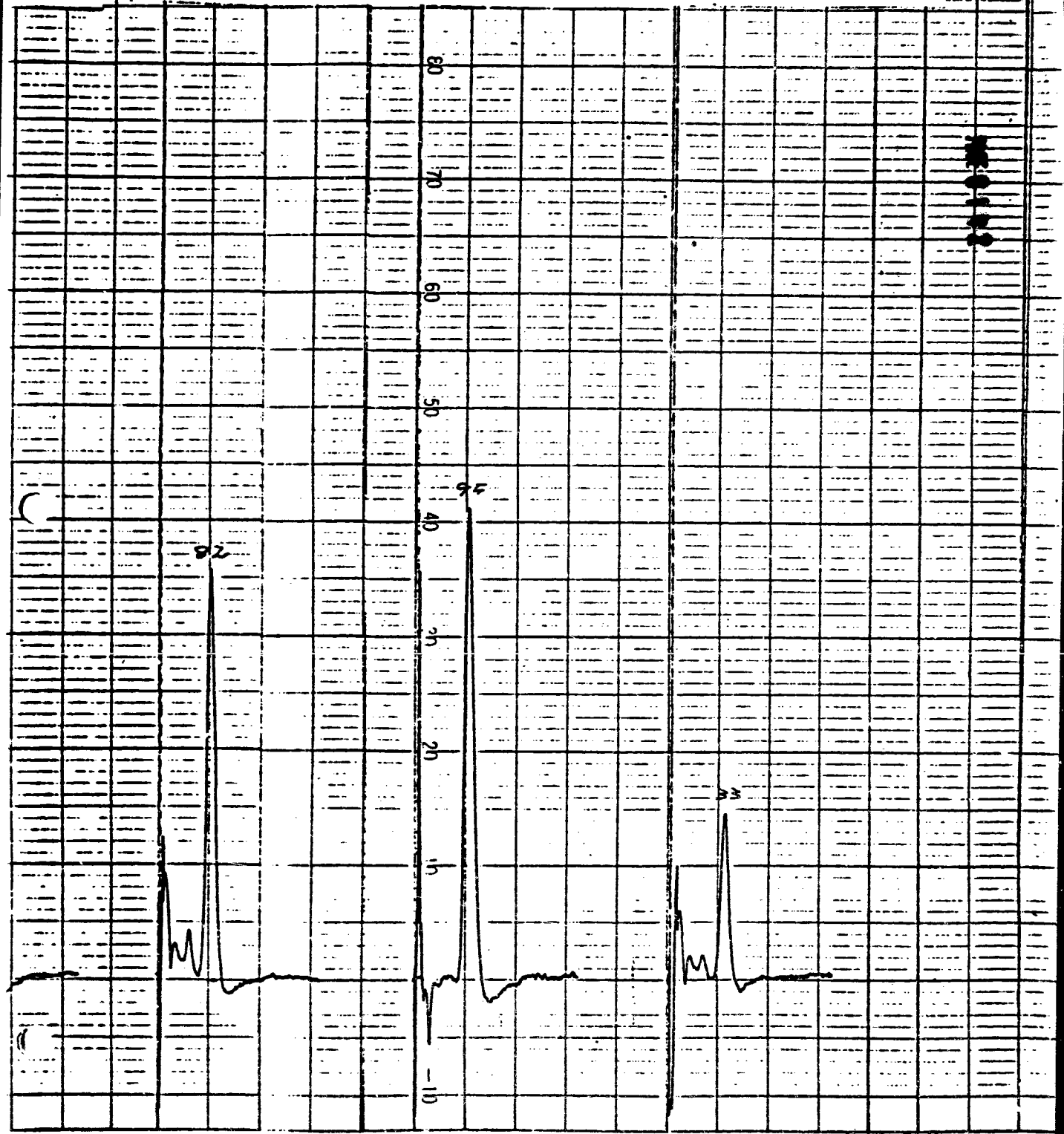
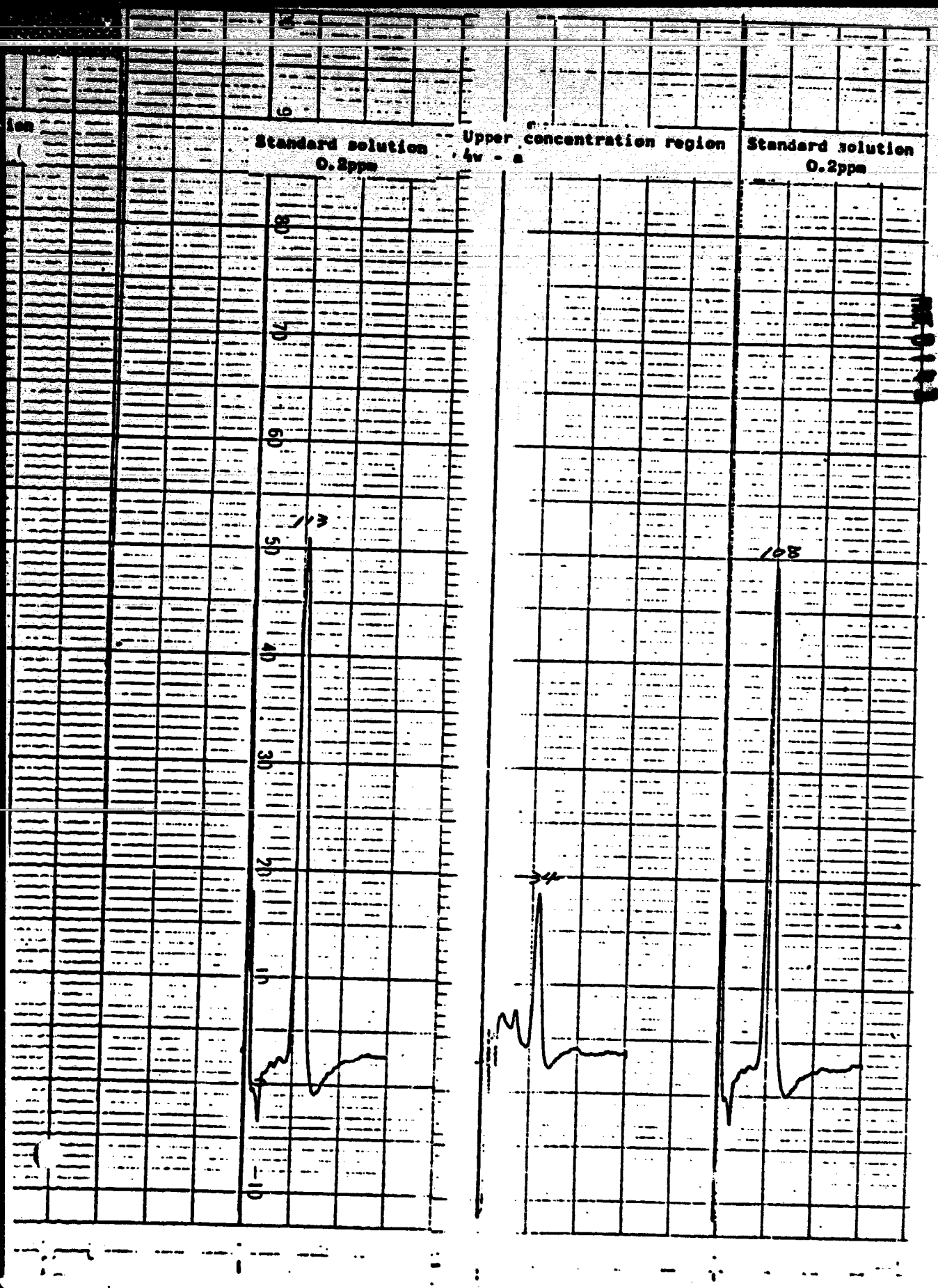
Chemical Biotesting Center

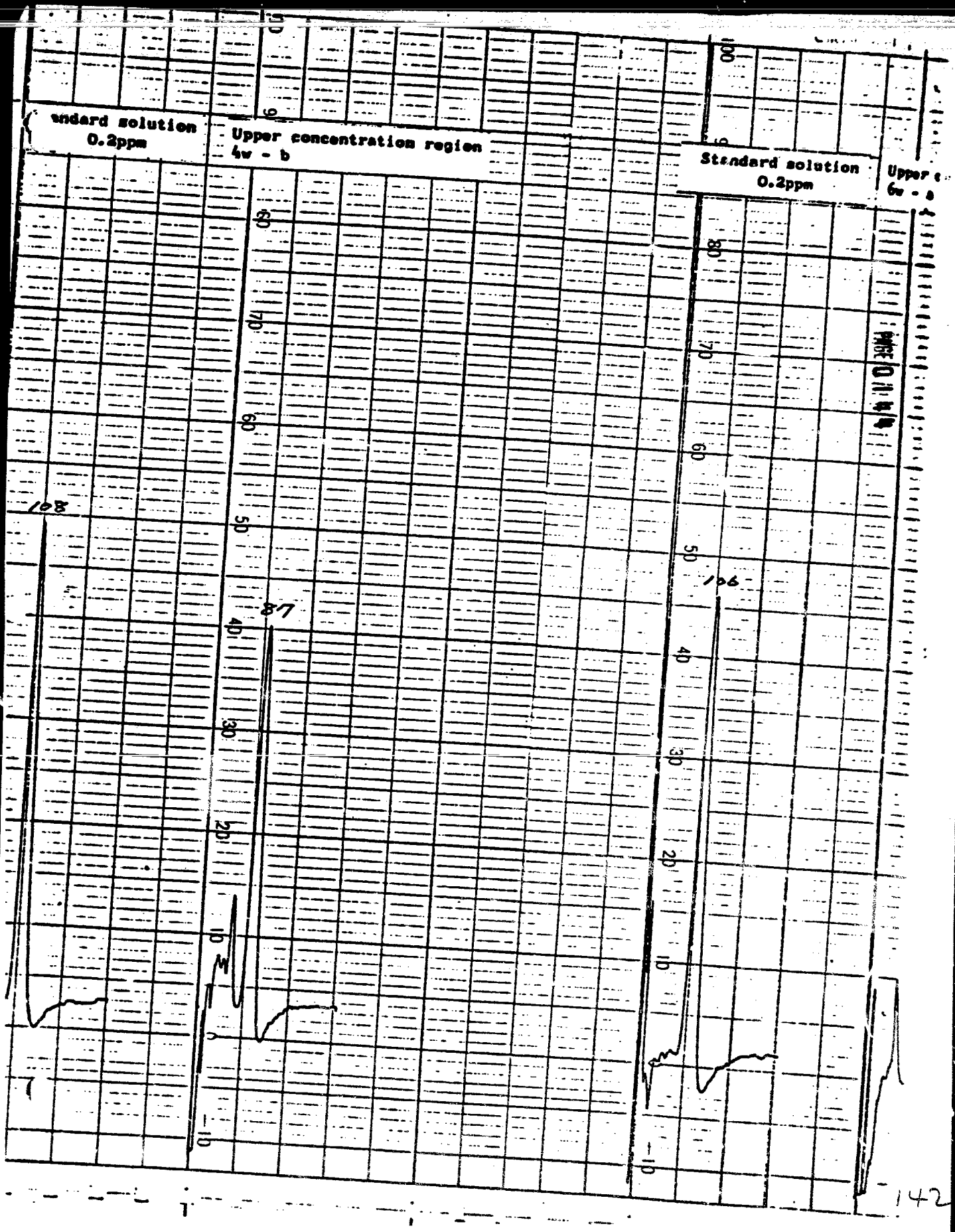
The figures above each peak show the peak height (mm)

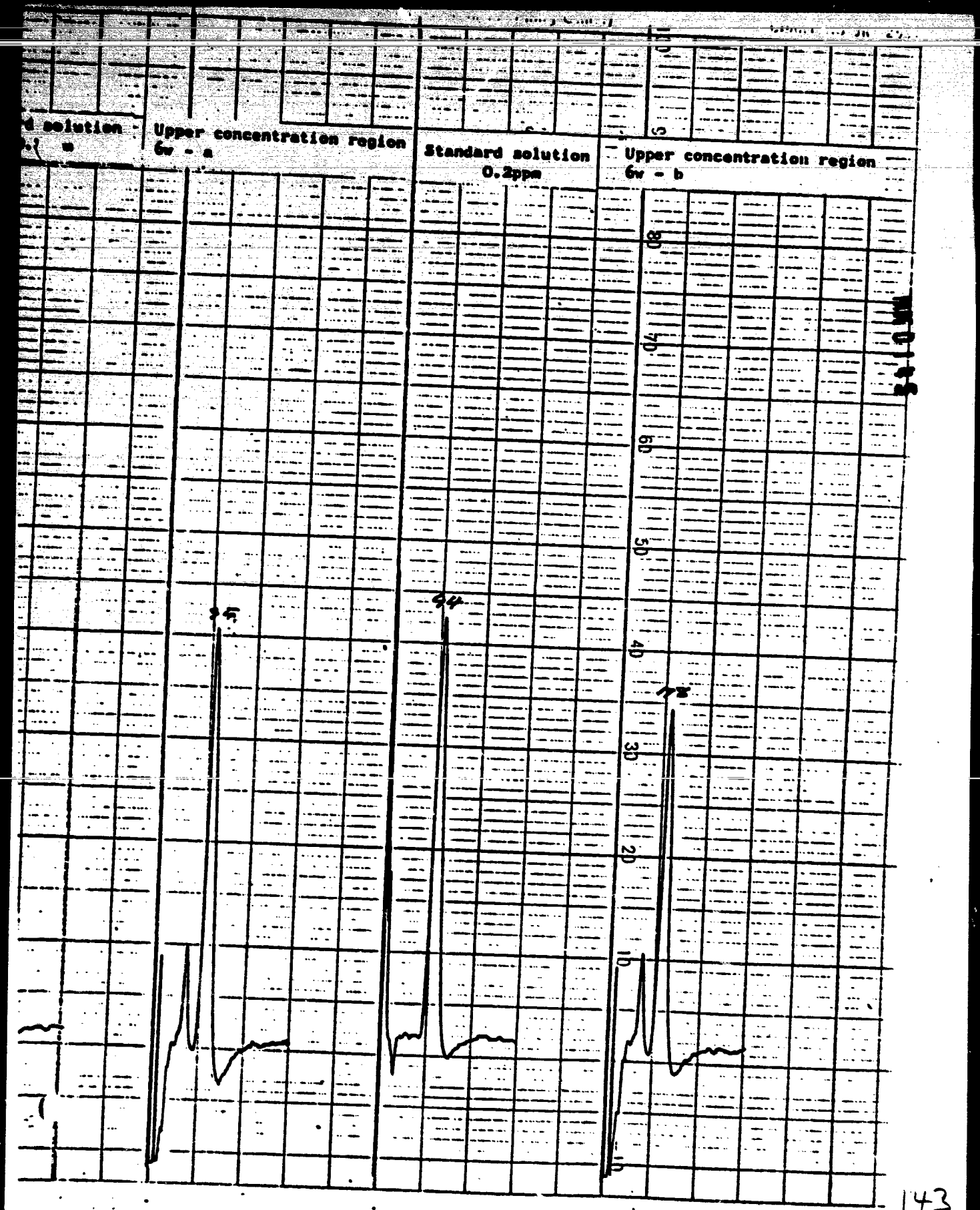
ppm	tion	Upper concentration region 2w - a	Standard solution 0.2ppm	Upper concentration region 2w - b



140


Standard solution
0.2ppm
Upper concentration region
4w - a
Standard solution
0.2ppm
113
108

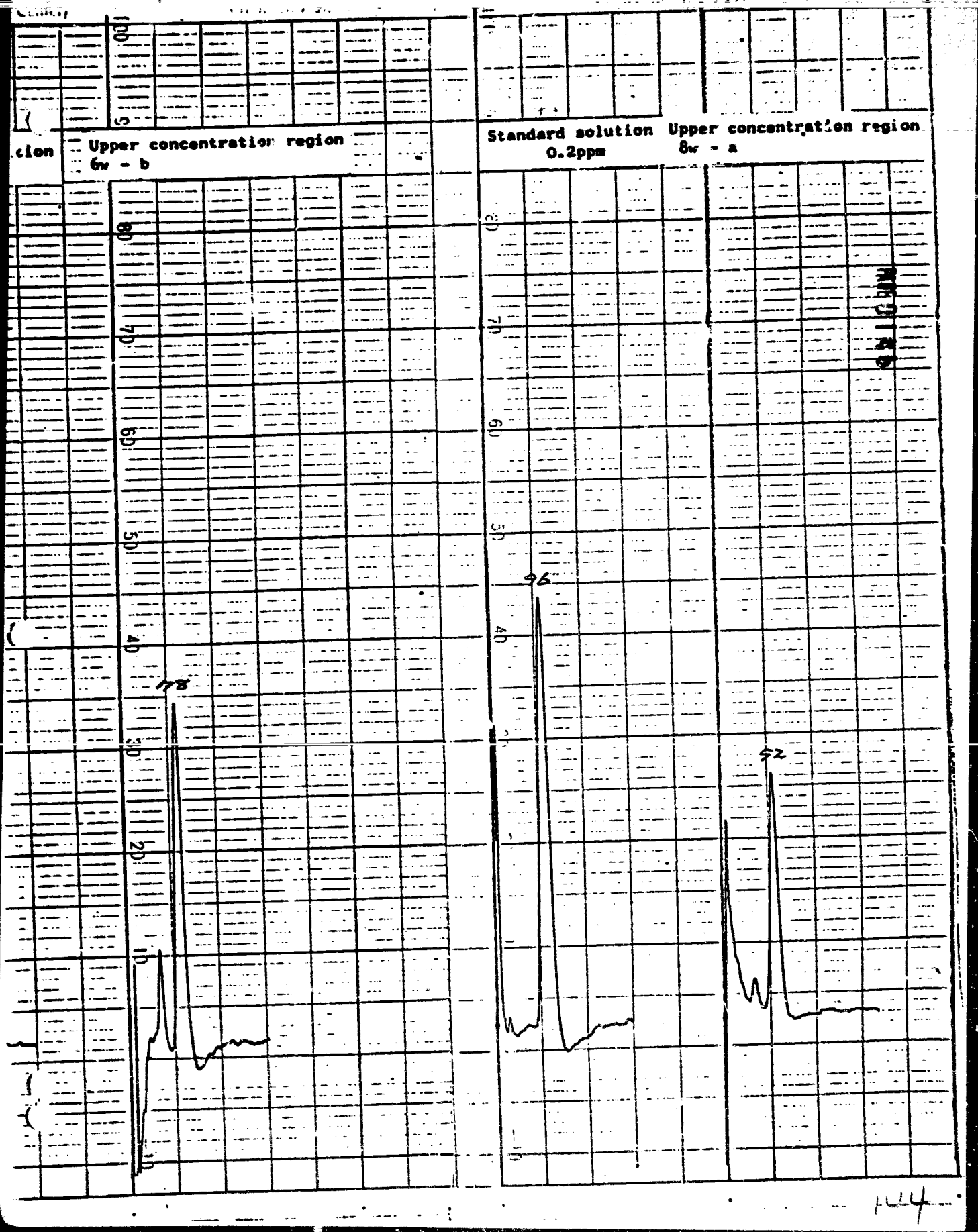

ndard solution
0.2ppm
Upper concentration region
4w - b
Standard solution
0.2ppm
Upper c
6w - a
108
87
106
142



d solution
Upper concentration region
6w - a
Standard solution
0.2ppm
Upper concentration region
6w - b
80
70
60
50
40
30
20
10

143

0115


Upper concentration region
6w - b
Standard solution
0.2ppm
Upper concentration region
8w - a
78
96
52

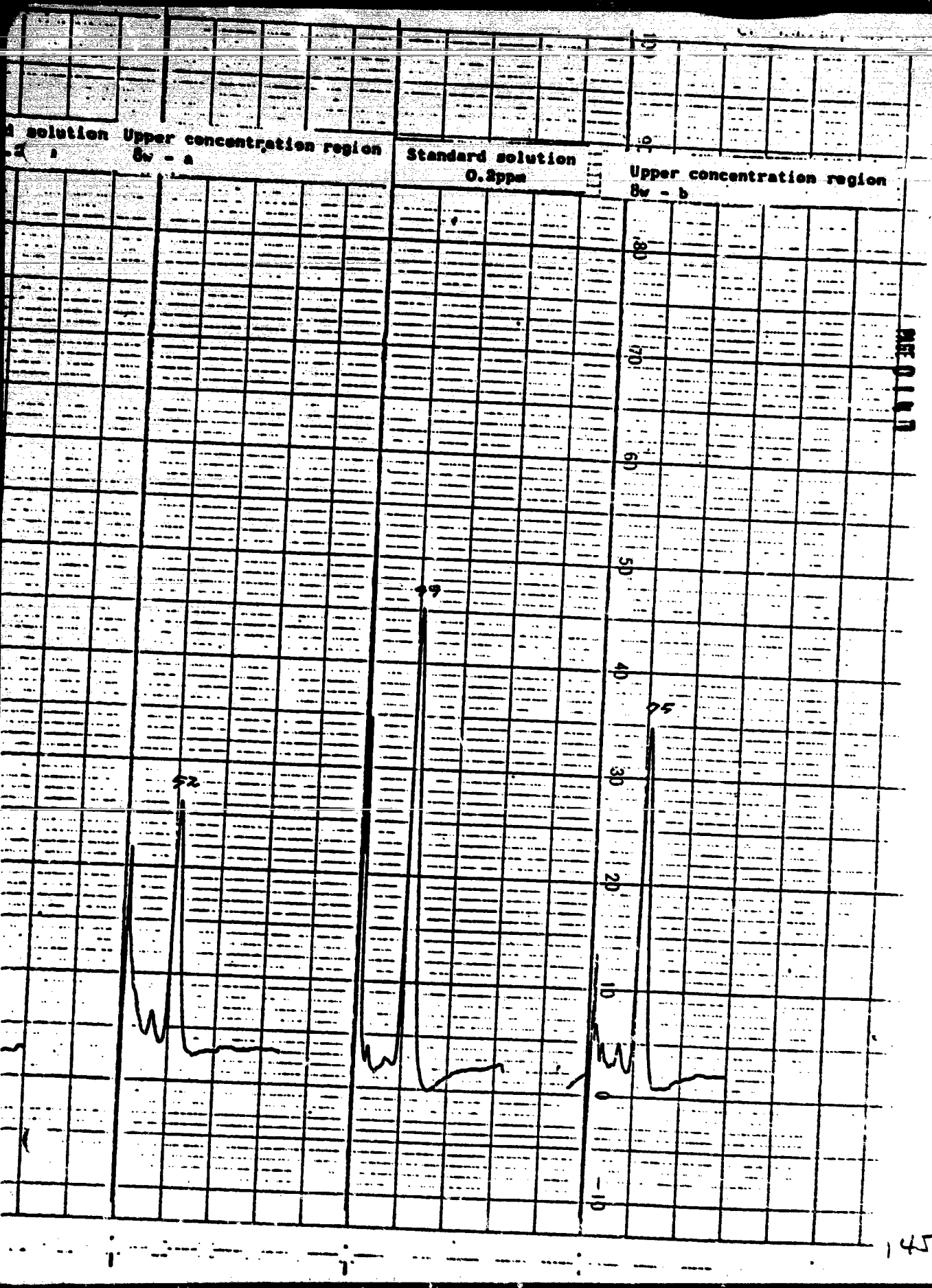

solution
Upper concentration region
Bw - a
Standard solution
0.2ppm
Upper concentration region
Bw - b
80
70
60
50
40
30
20
10
0
-10
52
49
45

Fig - 6

No. Fish 2

Date (31. AUG) (14. 28 SEP) (12. OCT) 1976

Room Temp. 25 ℃

Model JGC - 20K

Sample S - 82

GLS 4 ml/μ/mg.

Solvent Benzene

Column L. 0.3 m. I.D. 2 mm.

Temp. 215 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 nV/V

Sensitivity Hi x 8

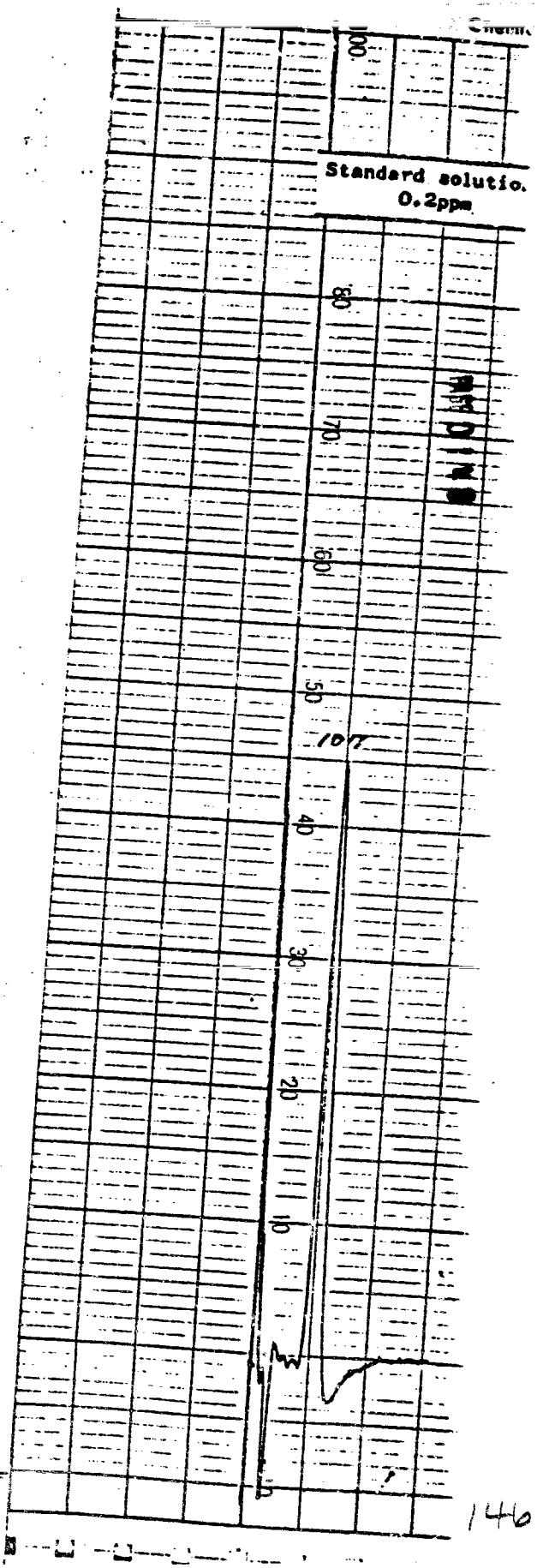
Detector Temp. 320 ℃

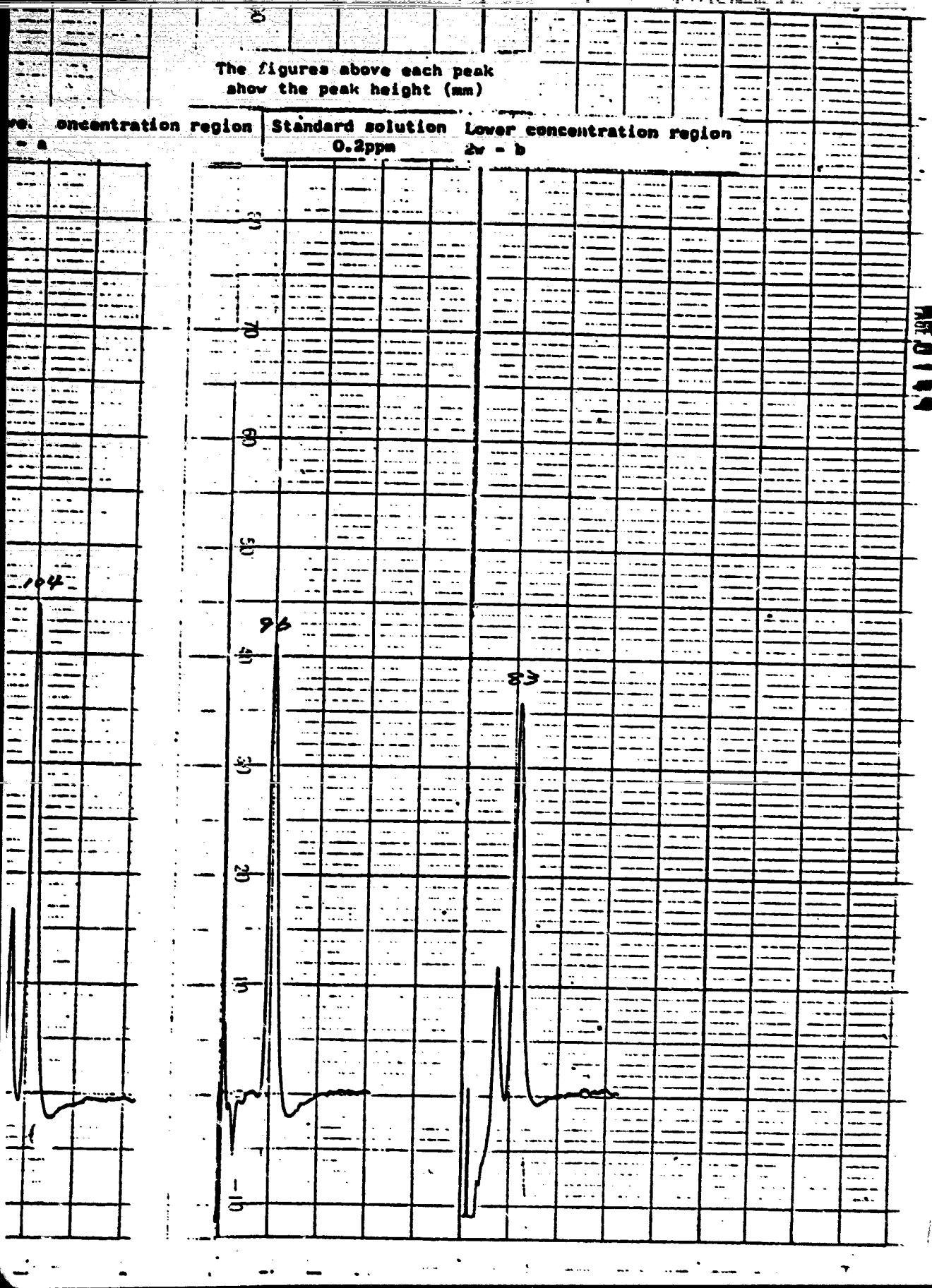
Injection Temp. 320 ℃

Chart Speed 5 mm/min.

Note :

Operator A Group





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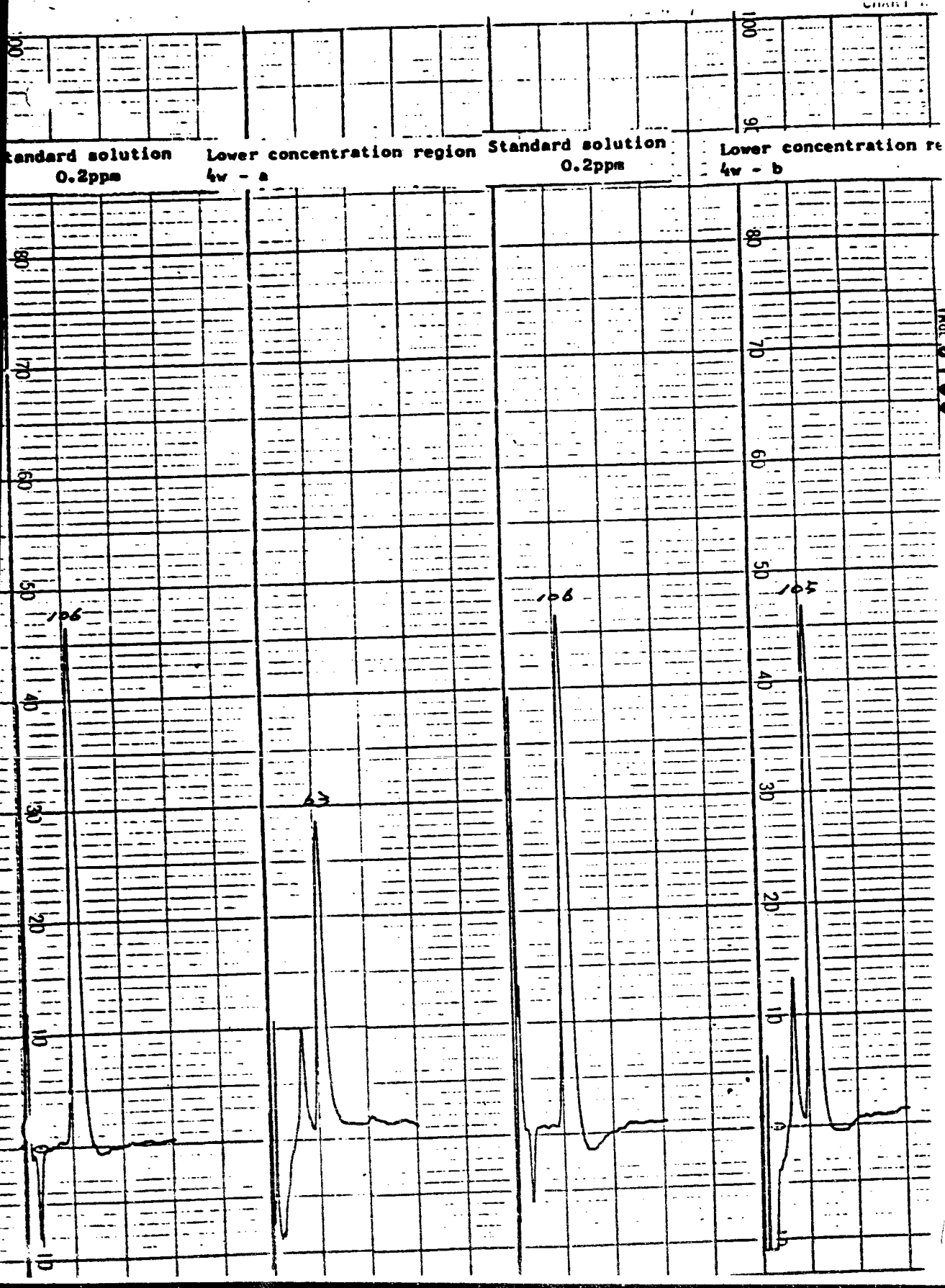
0 1 1 4


Standard solution
0.2ppm
Lower concentration region
4w - a
Standard solution
0.2ppm
Lower concentration re
4w - b
100
90
80
70
60
50
40
30
20
10
0
106
63
106
105

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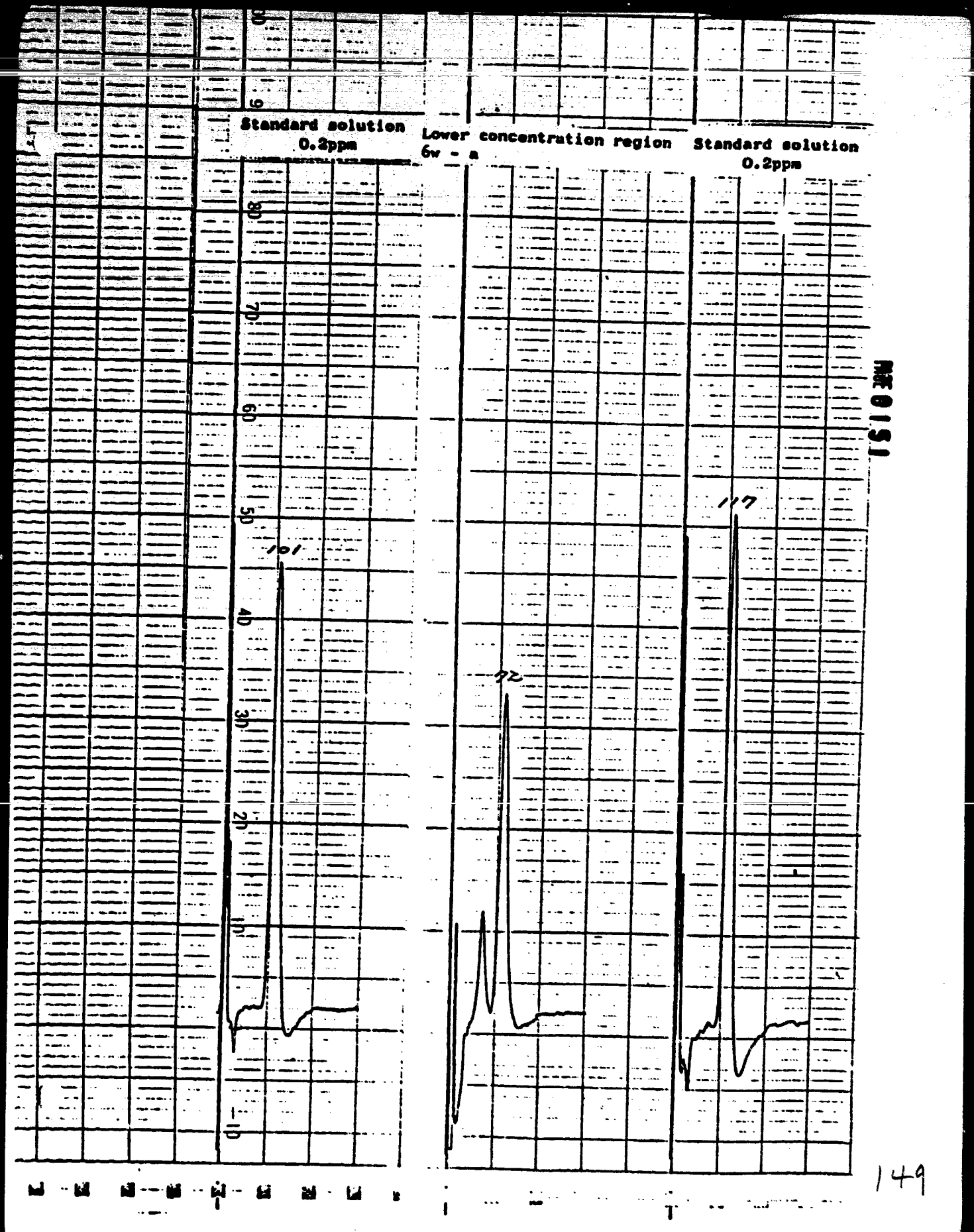
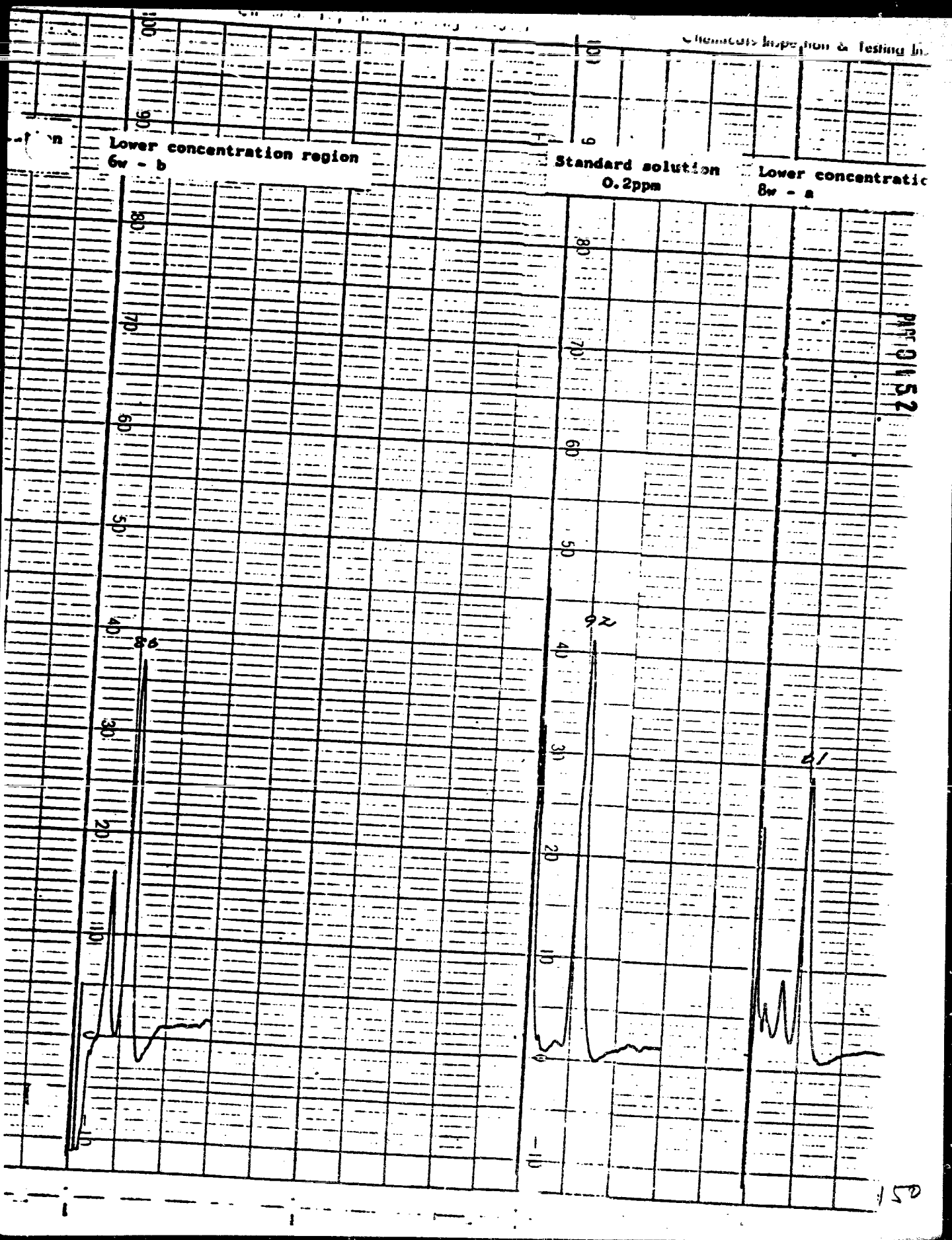
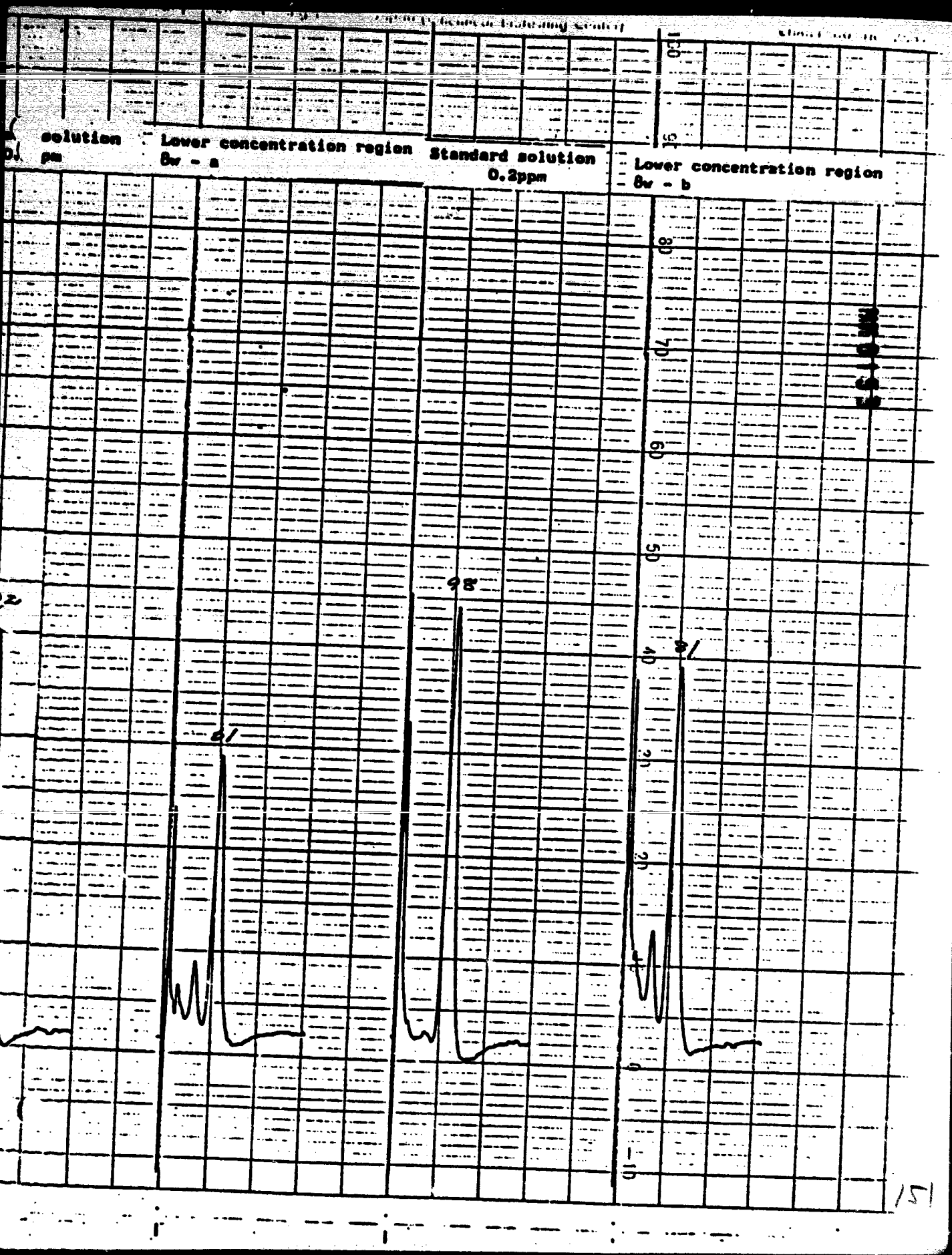

Standard solution
0.2ppm
Lower concentration region
6w - a
Standard solution
0.2ppm
9
8b
7b
6b
5b
4b
3b
2b
1b
101
92
117

149

0121


Lower concentration region
6w - b
Standard solution
0.2ppm
Lower concentratic
8w - a
80
70
60
50
40
30
20
10
0
-10
86
92
91


solution
pm
Lower concentration region
8w - a
Standard solution
0.2ppm
Lower concentration region
8w - b
98
81
61
80
70
60
50
40
30
20
10
0
-10

151

0 1 2 3

Fig- 7

S-82 48hrs - TLm Test

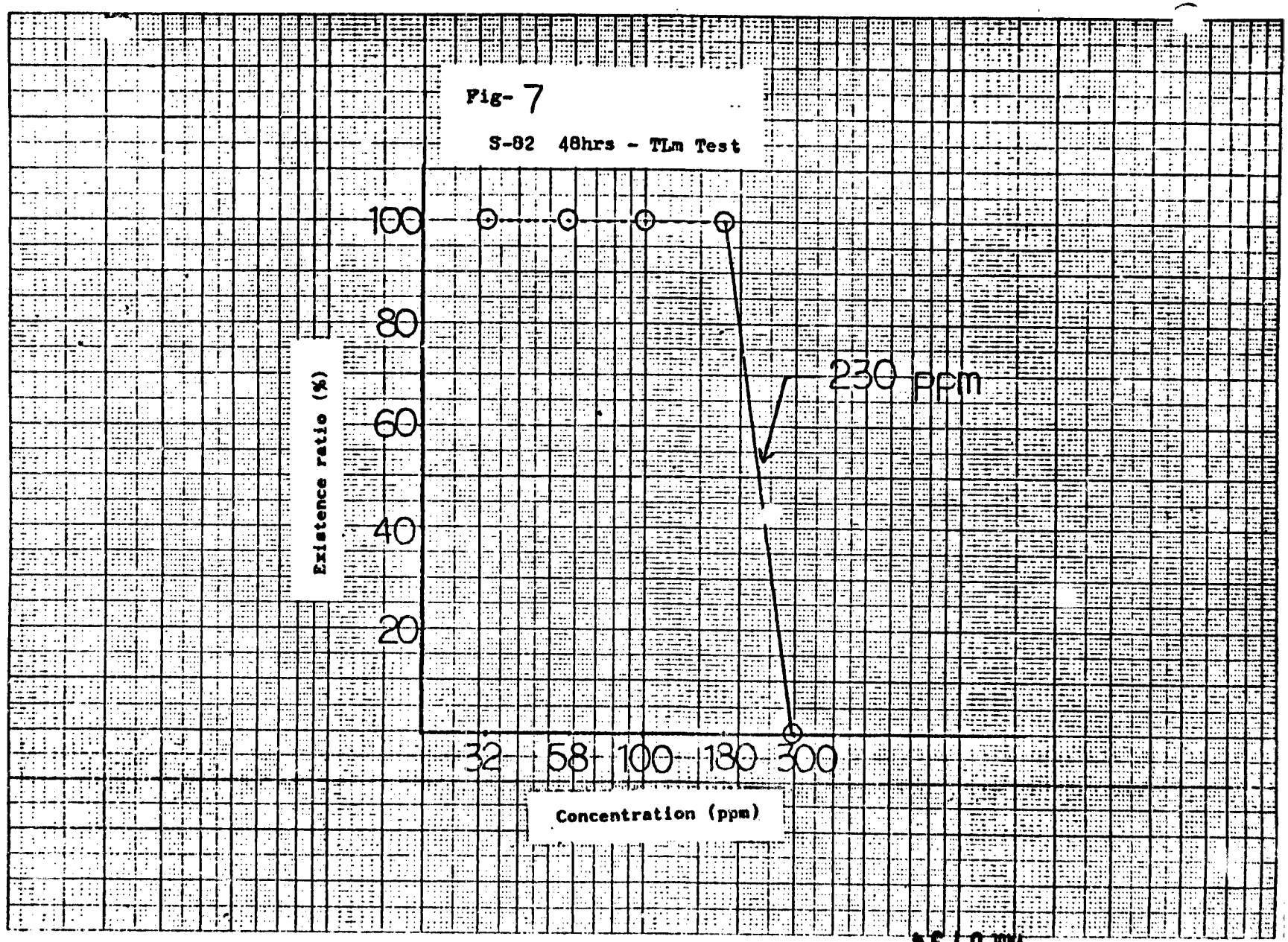


Fig - 8 Blank test

No. Recovery

Date 16. AUG 1976

Room Temp. 25 ℃

Model JGC - 20K

Sample S - 82

G(L)S. 4 ml(μ)mg.

Solvent Benzene

Column L. 0.3 m. I.D. 2 mm.

Temp. 235 ℃ ⇒ ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV)V

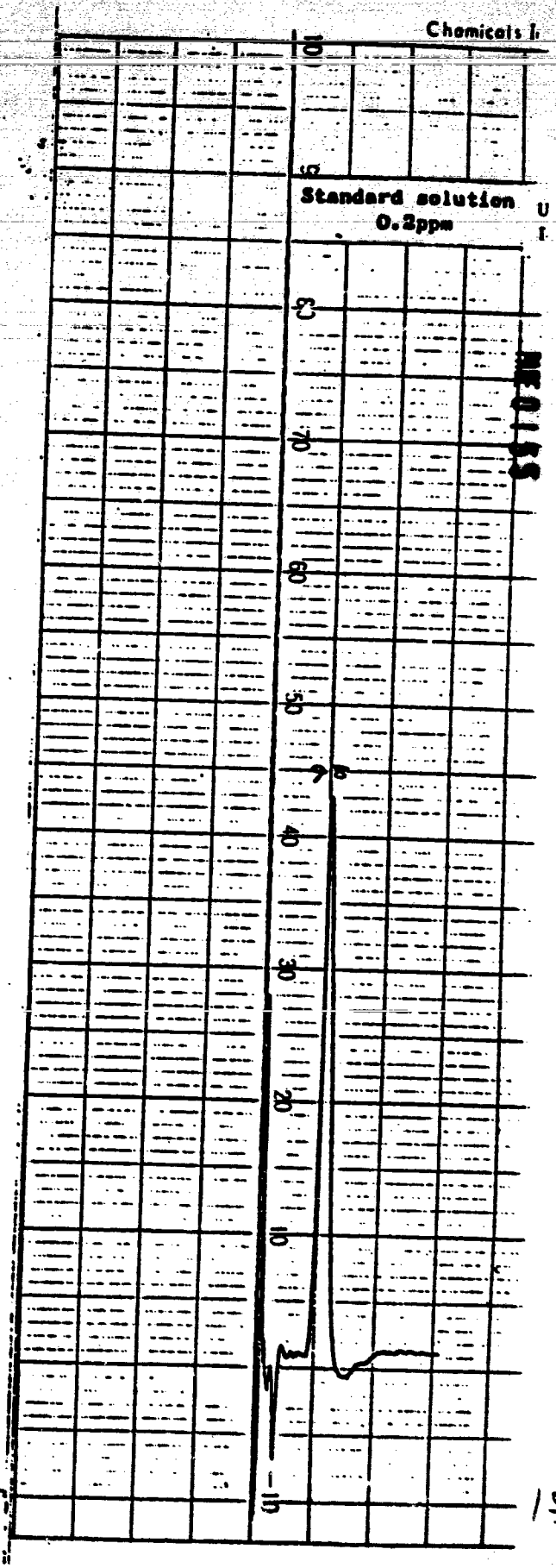
Sensitivity Hi x 8

Detector Temp. 320 ℃

Injection Temp. 320 ℃

Chart Speed 5 mm/min.

Operator A Group



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Chemical Biotesting Center

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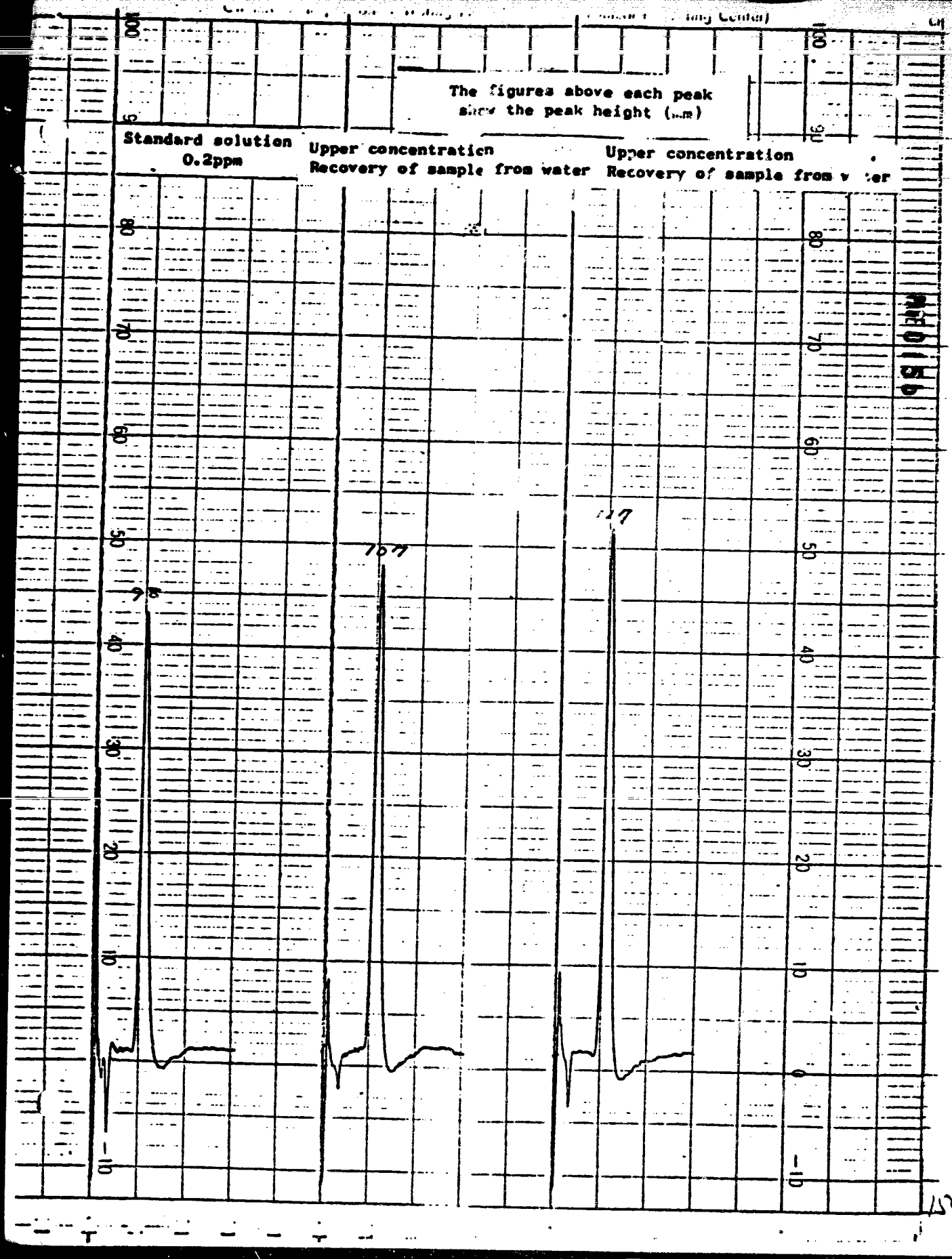
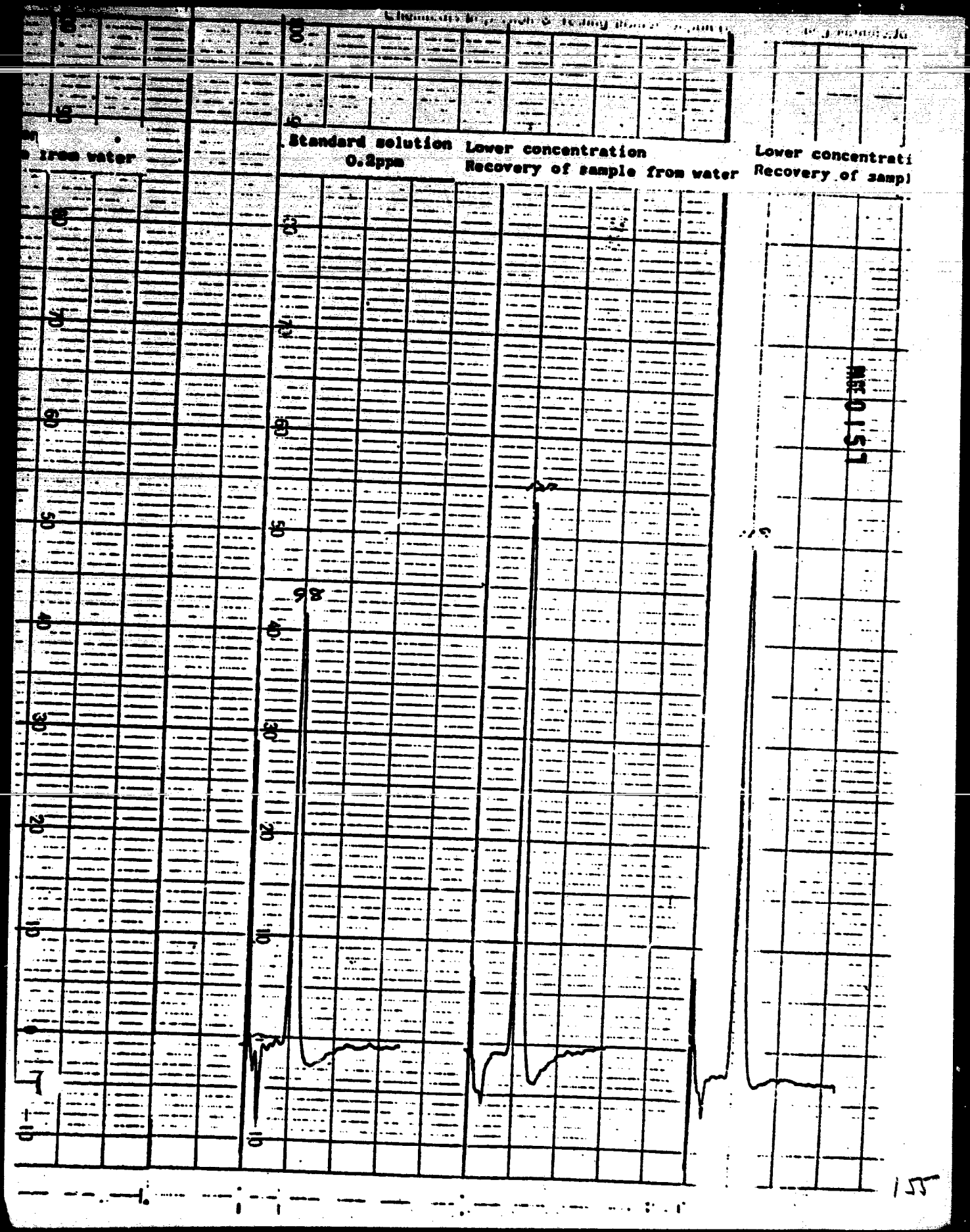
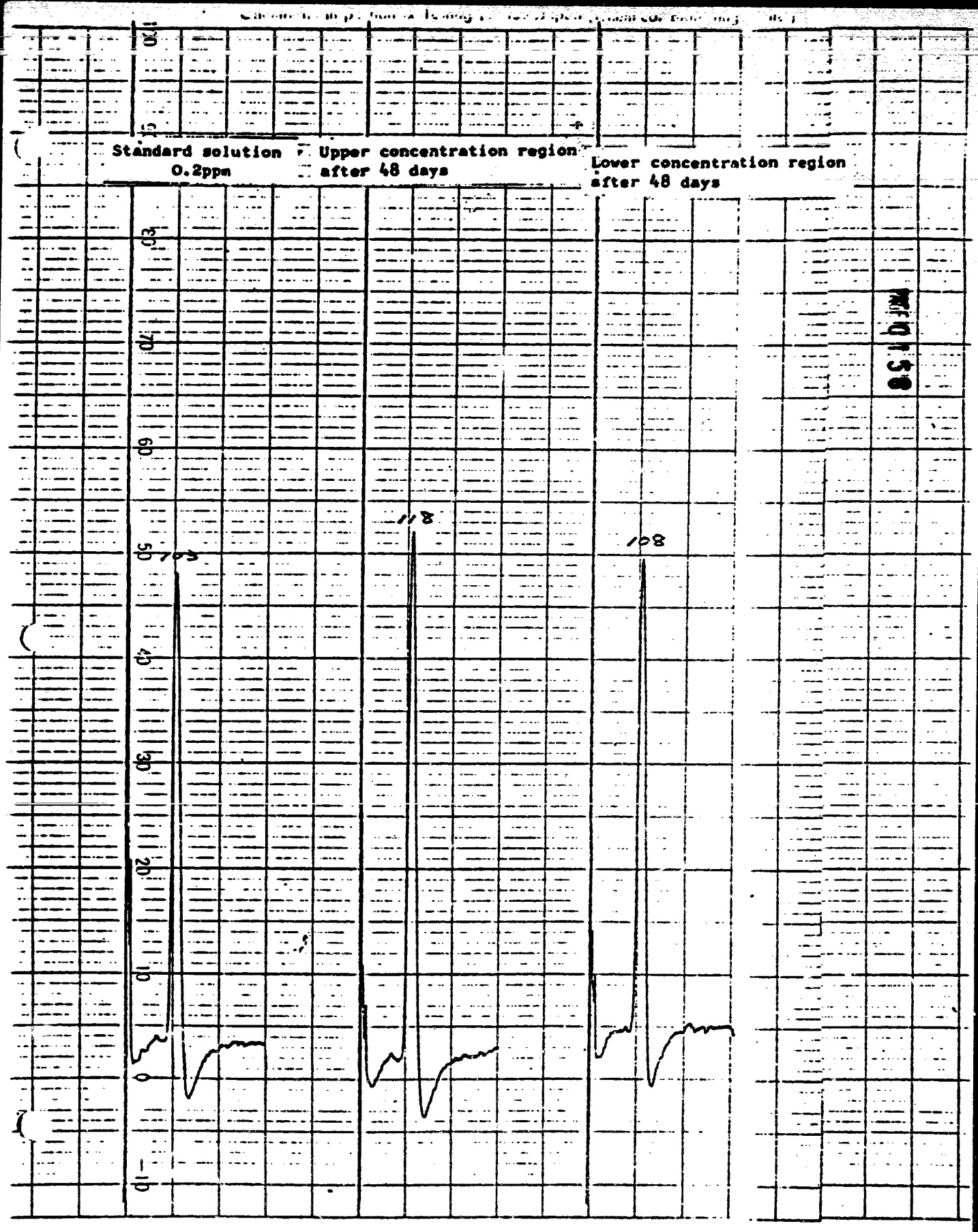
0125


The figures above each peak
show the peak height (mm)
Standard solution
0.2ppm
Upper concentration
Recovery of sample from water
Upper concentration
Recovery of sample from water
98
107
117
100
90
80
70
60
50
40
30
20
10
0
-10

154

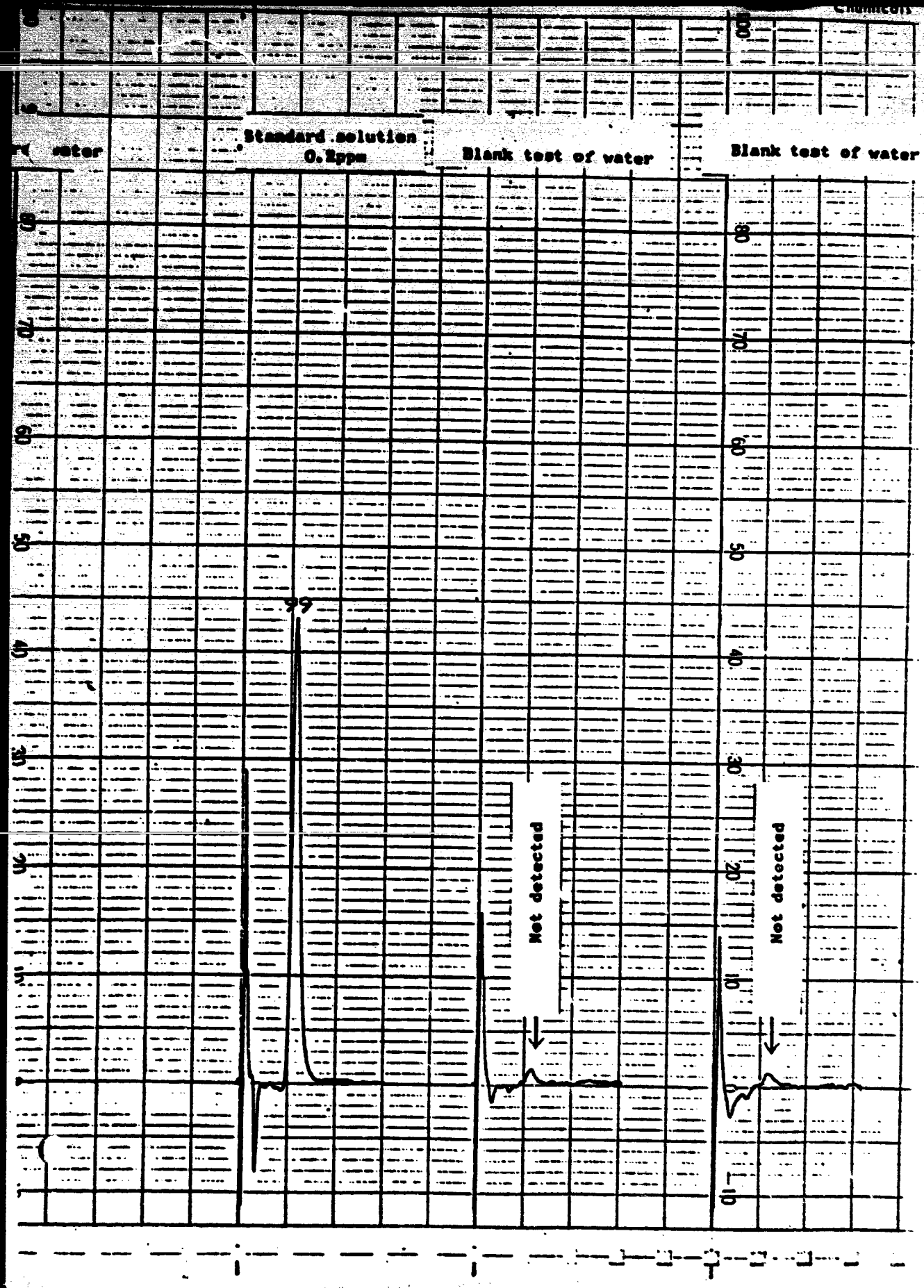
0126


from water
Standard solution
0.2ppm
Lower concentration
Recovery of sample from water
Lower concentrati
Recovery of sampl
MADE IN U.S.A.


Standard solution
0.2ppm
Upper concentration region
after 48 days
Lower concentration region
after 48 days
103
118
108
80
70
60
50
40
30
20
10
0
-10

1-1-156

0128


Standard solution
0.2ppm
Blank test of water
Blank test of water
99
Not detected
Not detected

MR 0159

0129

Fig - 9

No. Water 1

Date (19, 23, 26, 30, AUG.) 1976

Room Temp. 25 ℃

Model JGC - 20K

Sample S - 82

G (L) S. 4 ml (μ) mg.

Solvent. Benzene

Column L. 0.1 m. I.D. 2 mm.

Temp. 215 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV) V

Sensitivity Hi x 8

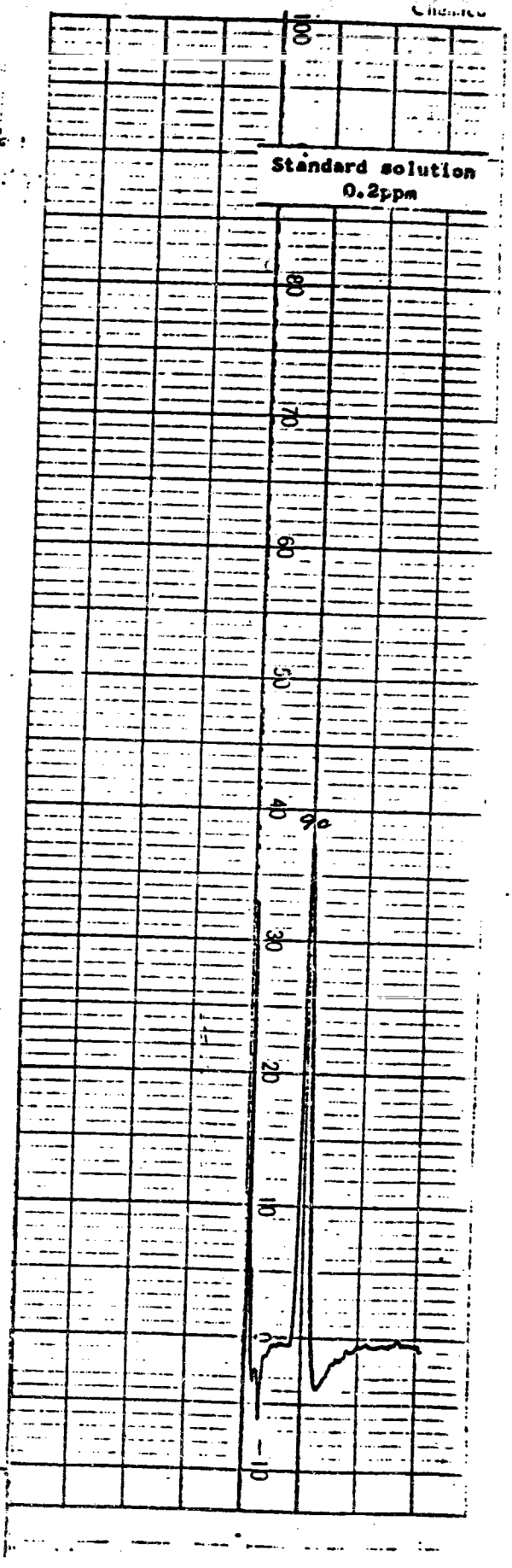
Detector Temp. 320 ℃

Injection Temp. 320 ℃

Chart Speed 5 mm/min.

Note :

Operator A Group



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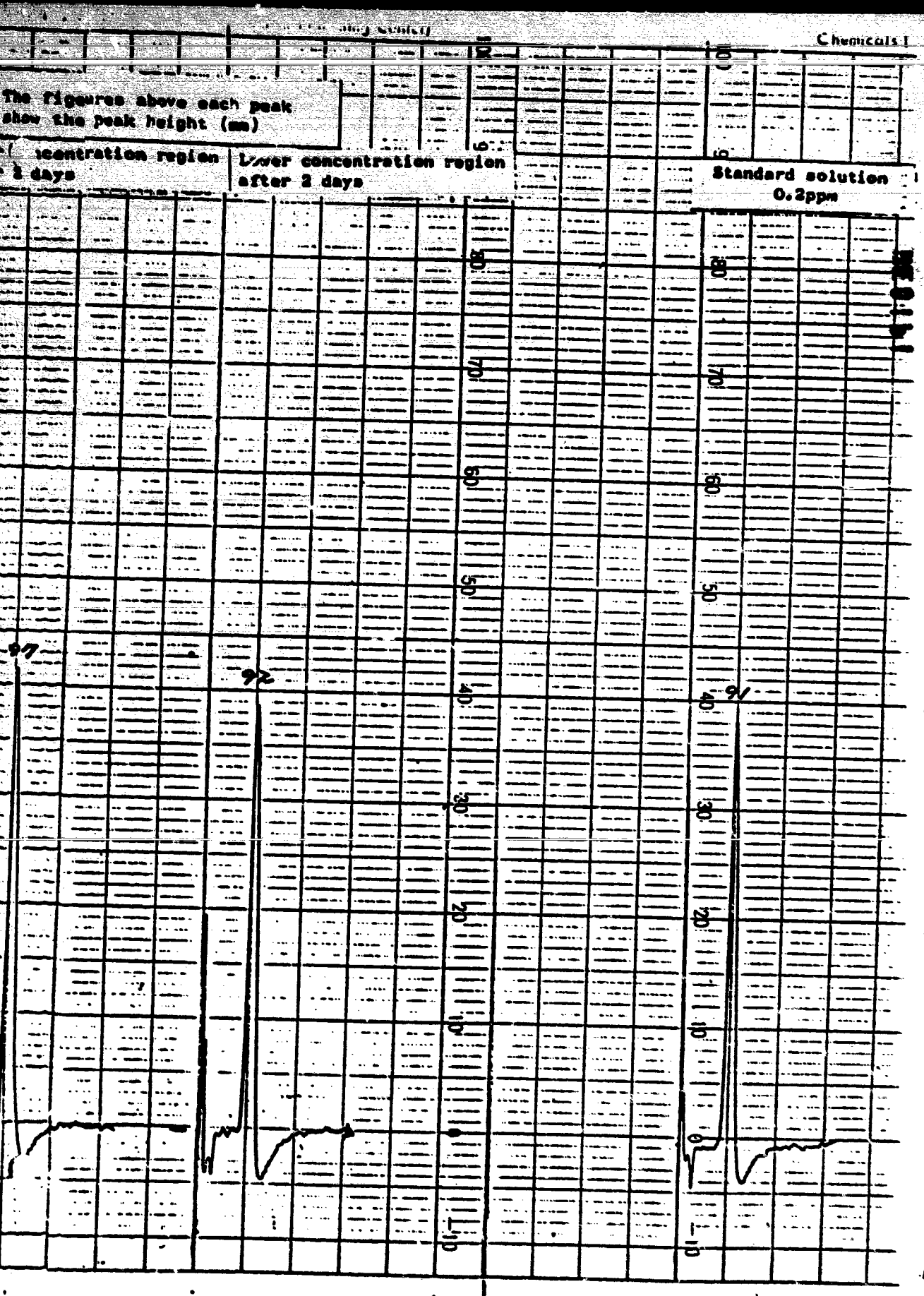
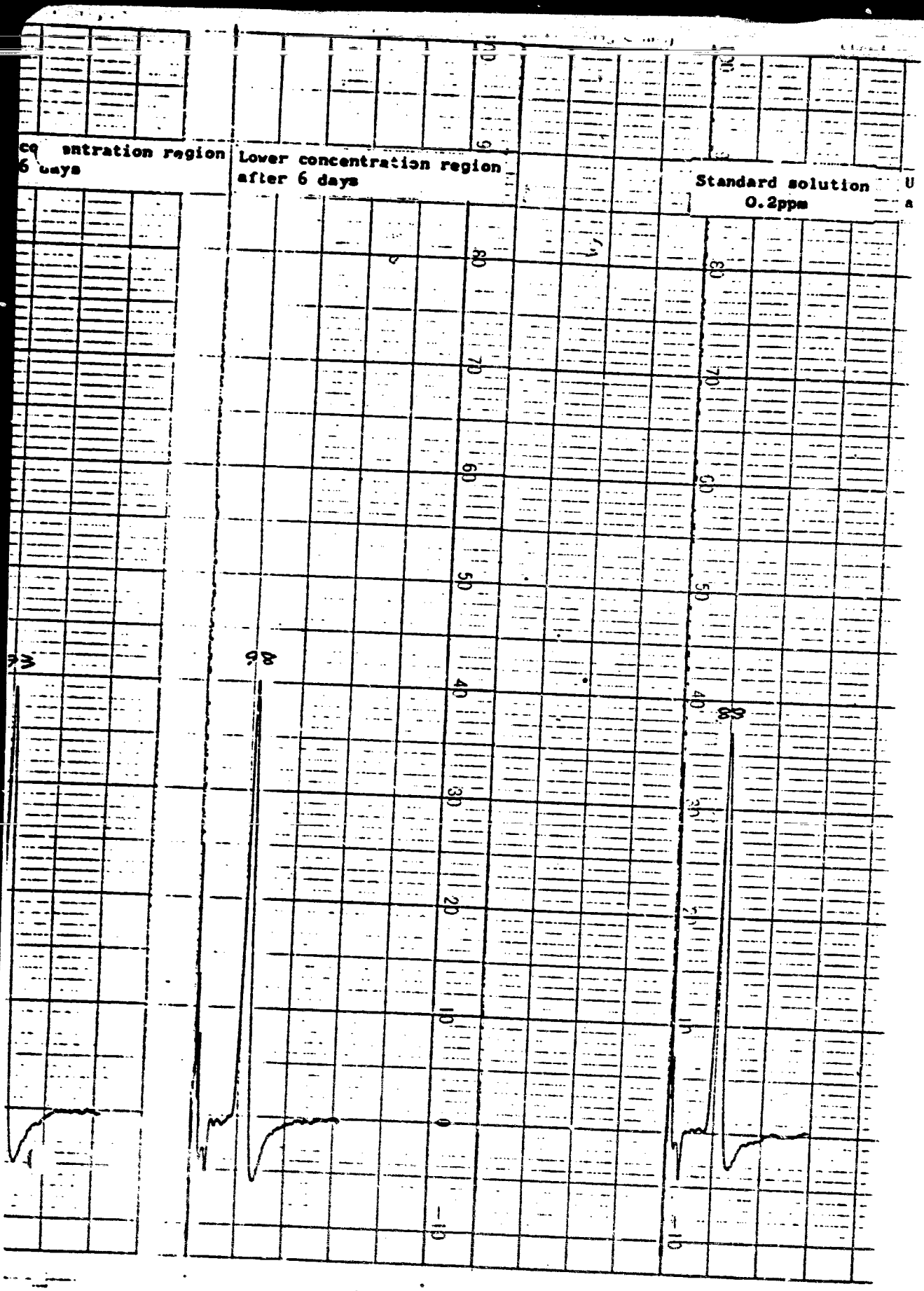

The figures above each peak show the peak height (mm)
Lower concentration region after 2 days
Standard solution 0.2ppm
97
92
91



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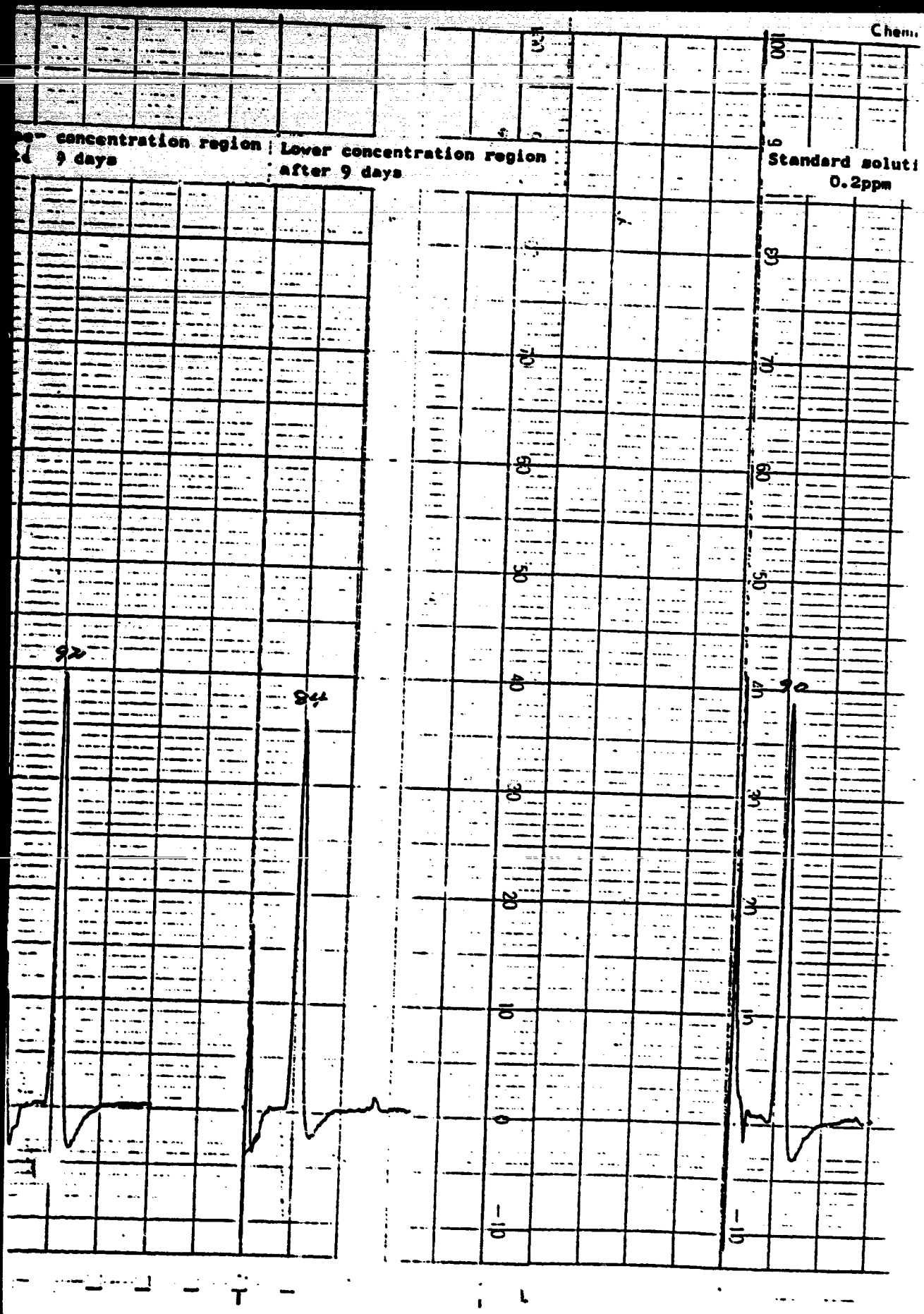
160



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0133

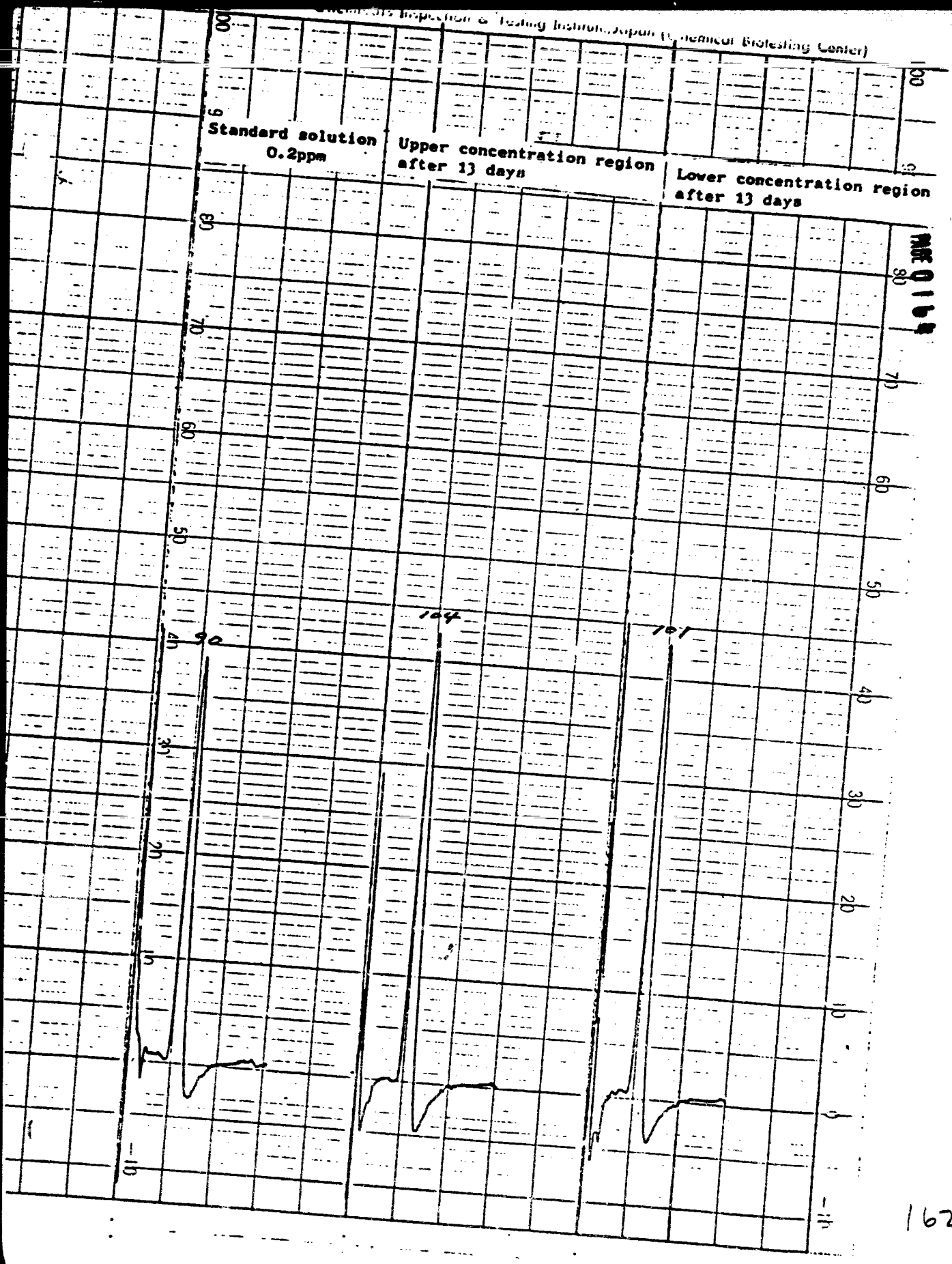

Standard solution
0.2ppm
Upper concentration region
after 13 days
Lower concentration region
after 13 days
90
104
101

Fig - 10

No. Water 12

Date (3.6.9.13. SEP) 1976

Room Temp. 25 ℃

Model JGC - 20K

Sample S. 82

G(L)S. 4 ml(μ)mg.

Solvent Benzene

Column L. 0.3 m. I.D. 2 mm.

Temp. 235 ℃ ⇒ ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV)V

Sensitivity Hi x 8

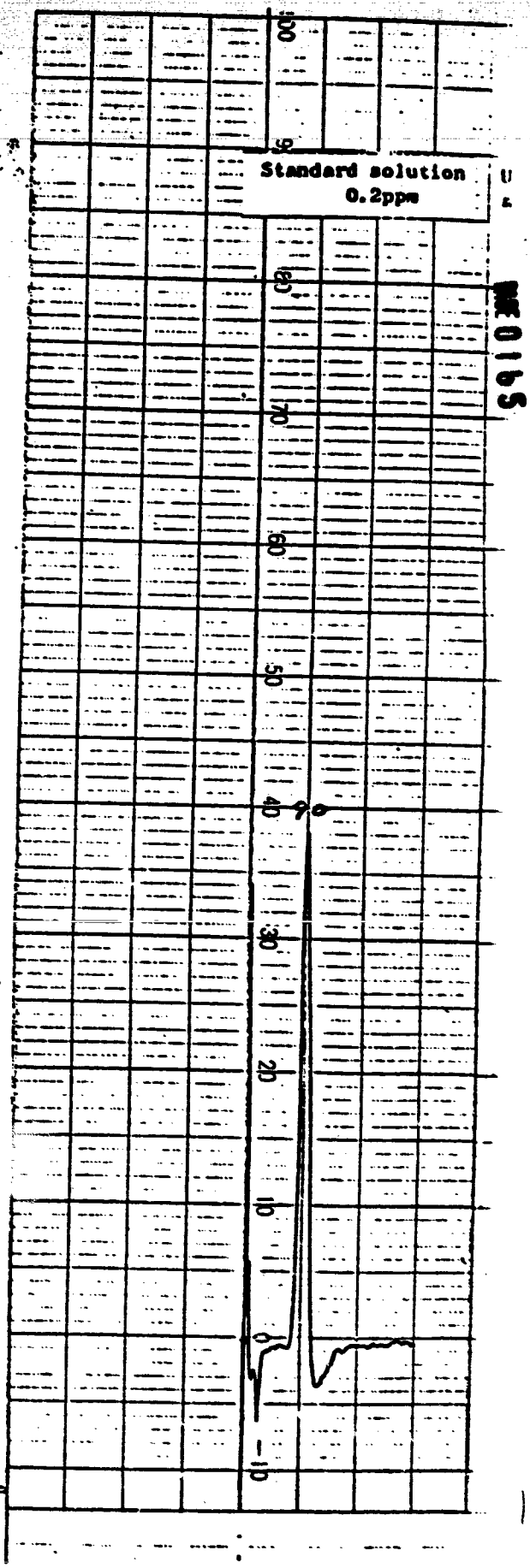
Detector Temp. 320 ℃

Injection Temp. 320 ℃

Chart Speed 5 mm/min.

ote :

Operator A Group



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Chemical Biotesting Center

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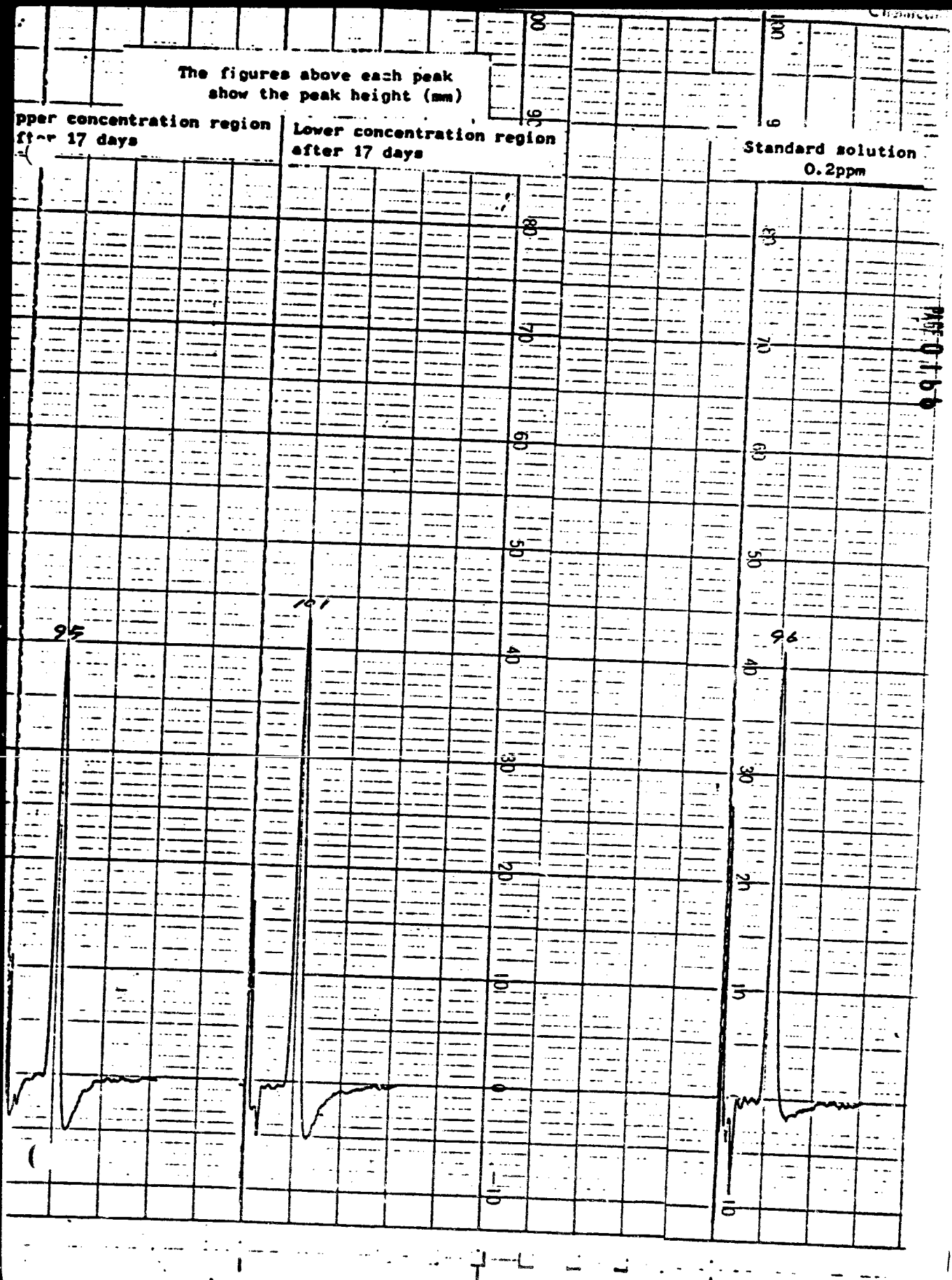
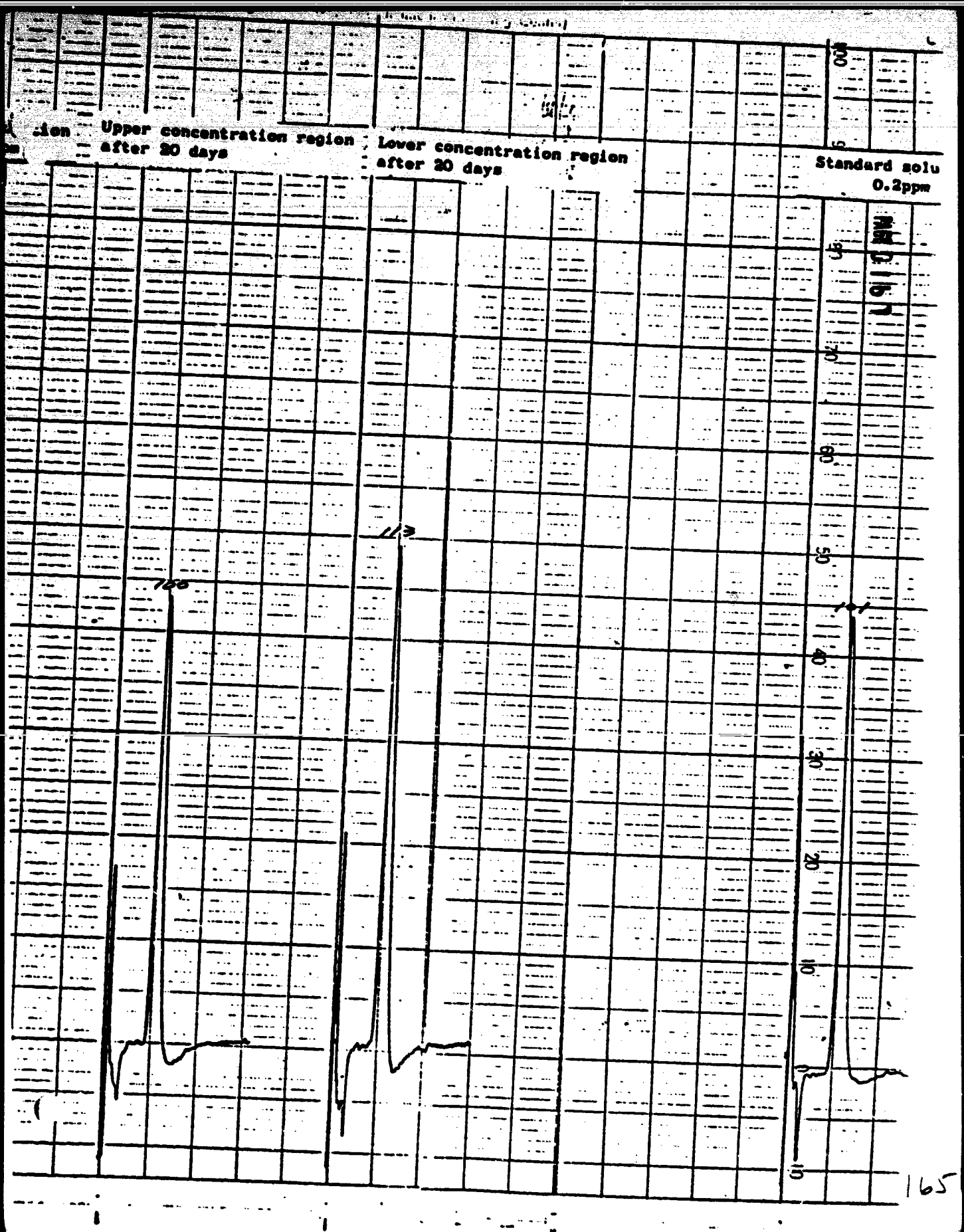
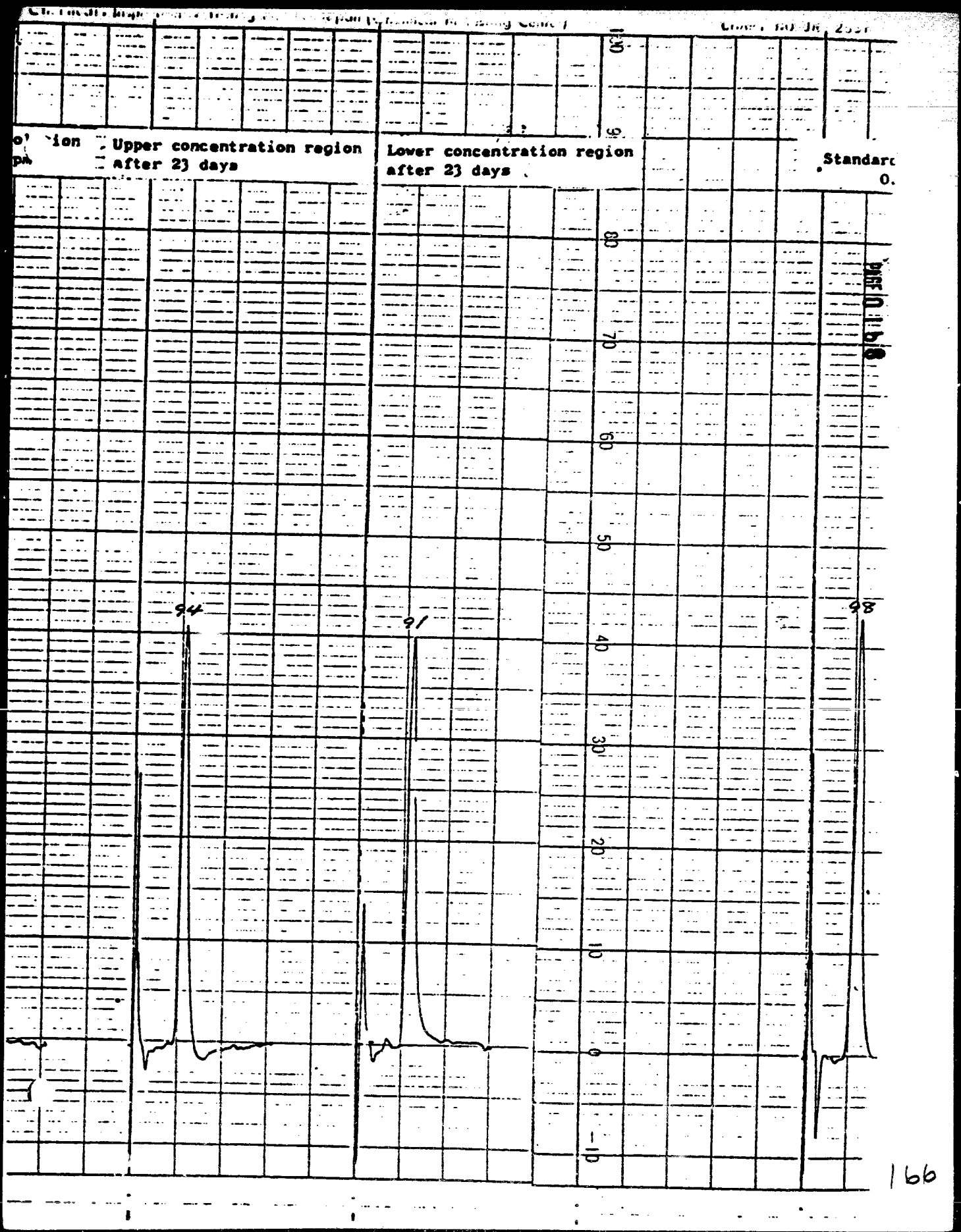

The figures above each peak show the peak height (mm)
pper concentration region
ft~r 17 days
Lower concentration region
after 17 days
Standard solution
0.2ppm
95
141
96


Upper concentration region
after 20 days
Lower concentration region
after 20 days
Standard solu
0.2ppm



Upper concentration region after 23 days
Lower concentration region after 23 days
Standard
94
91
98

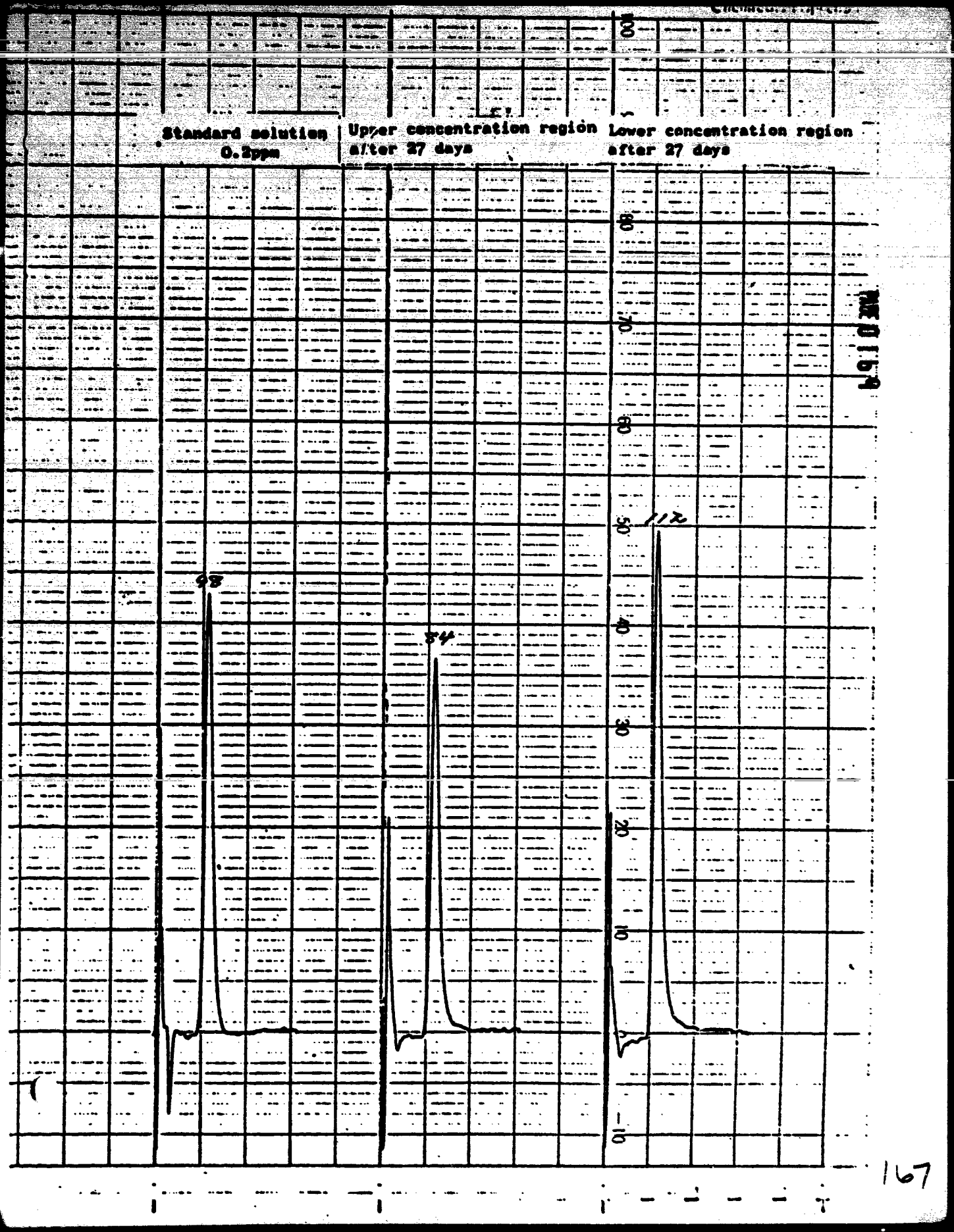

Standard solution
0.2ppm
Upper concentration region
after 27 days
Lower concentration region
after 27 days
98
84
112
100
80
70
60
50
40
30
20
10
-10

Fig - 11

No. Water 3

Date (20, 27. SEP) (4, 12. OCT) 1976

Room Temp. 25 ℃

Model JGC - 20K

Sample S - 82

GLS. 4 ml(μl) mg.

Solvent Benzene

Column L. 0.3 m. I.D. 2 mm.

Temp. 235 ℃ → ℃

Temp. Rate ℃/min.

Liq. Phase DC - 200

wt. % 2

Support Gas - chrom Q

Mesh 80 - 100

Treatment

Ref. Column

Carrier Gas N_2

Flow Rate A : 2.0 kg/cm² (ml/min)

B : kg/cm² (ml/min)

H_2 Flow Rate A : kg/cm² (ml/min)

B : kg/cm² (ml/min)

Air Flow Rate kg/cm² (l/min)

Detector ECD

Rad. Source ^{63}Ni

Range 1.1 (mV)V

Sensitivity Hi x 8

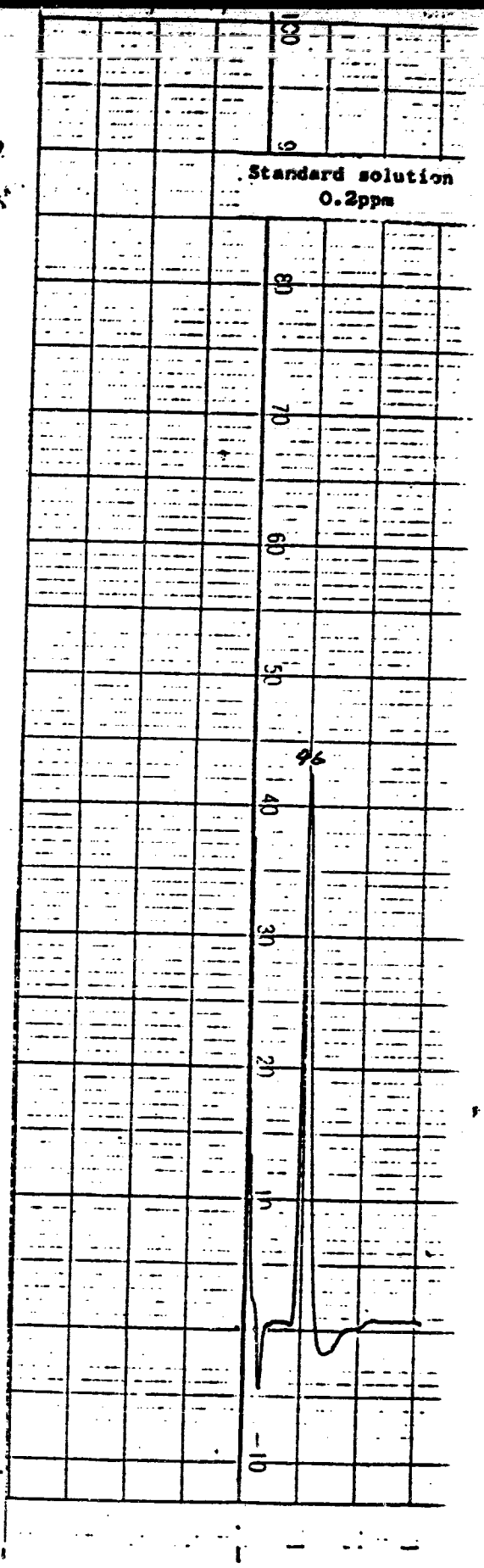
Detector Temp. 320 ℃

Injection Temp. 320 ℃

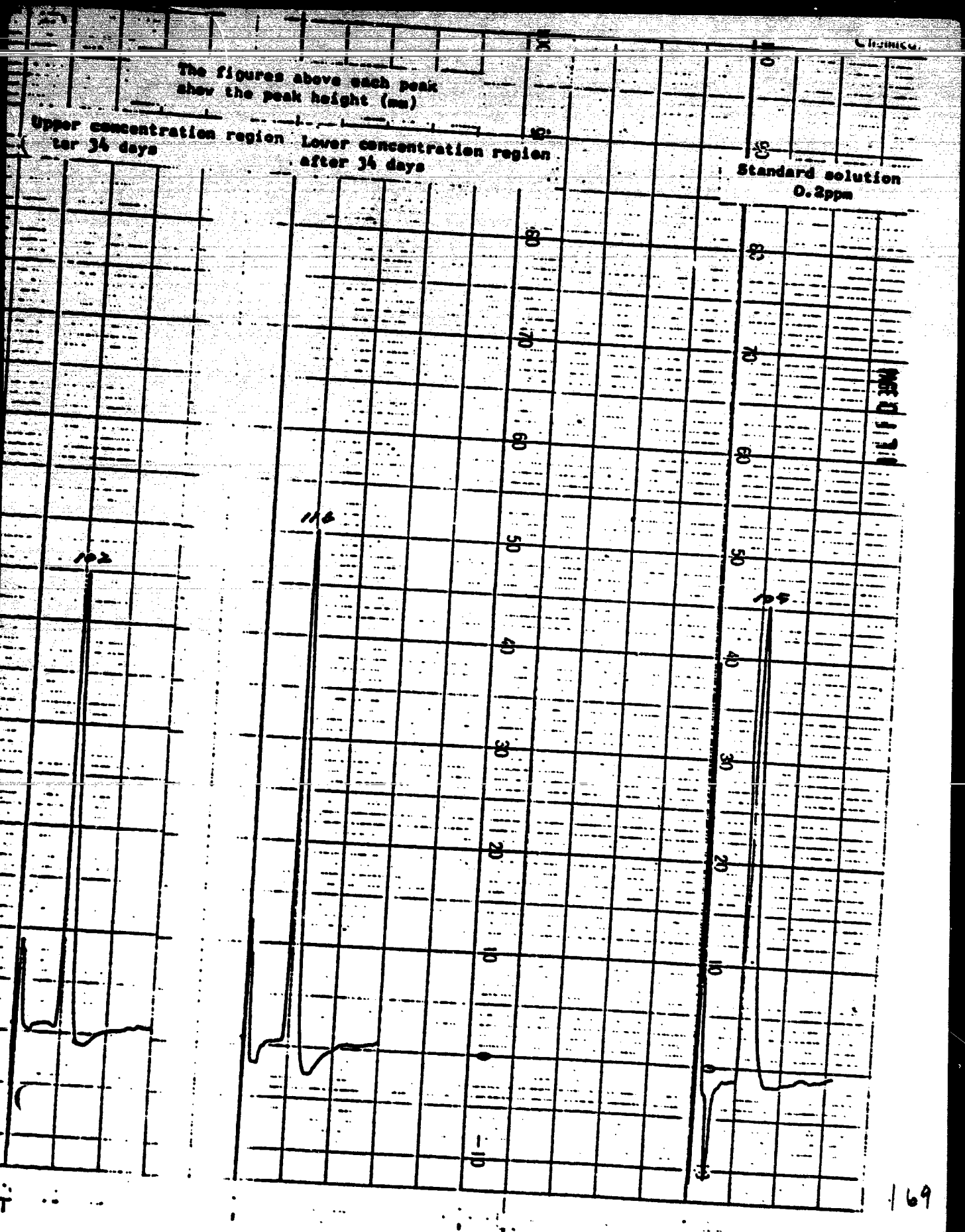
Chart Speed 5 mm/min.

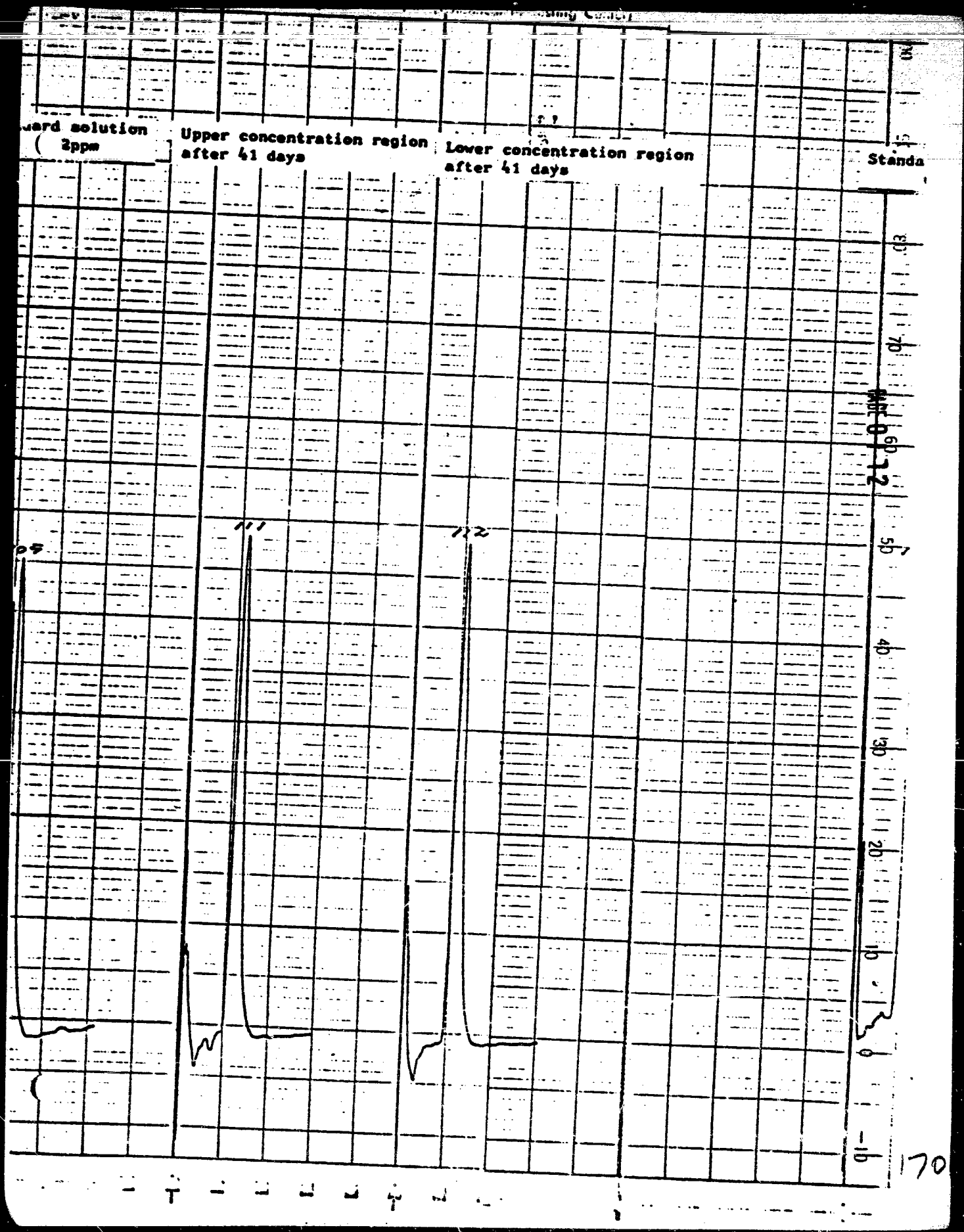
Note :

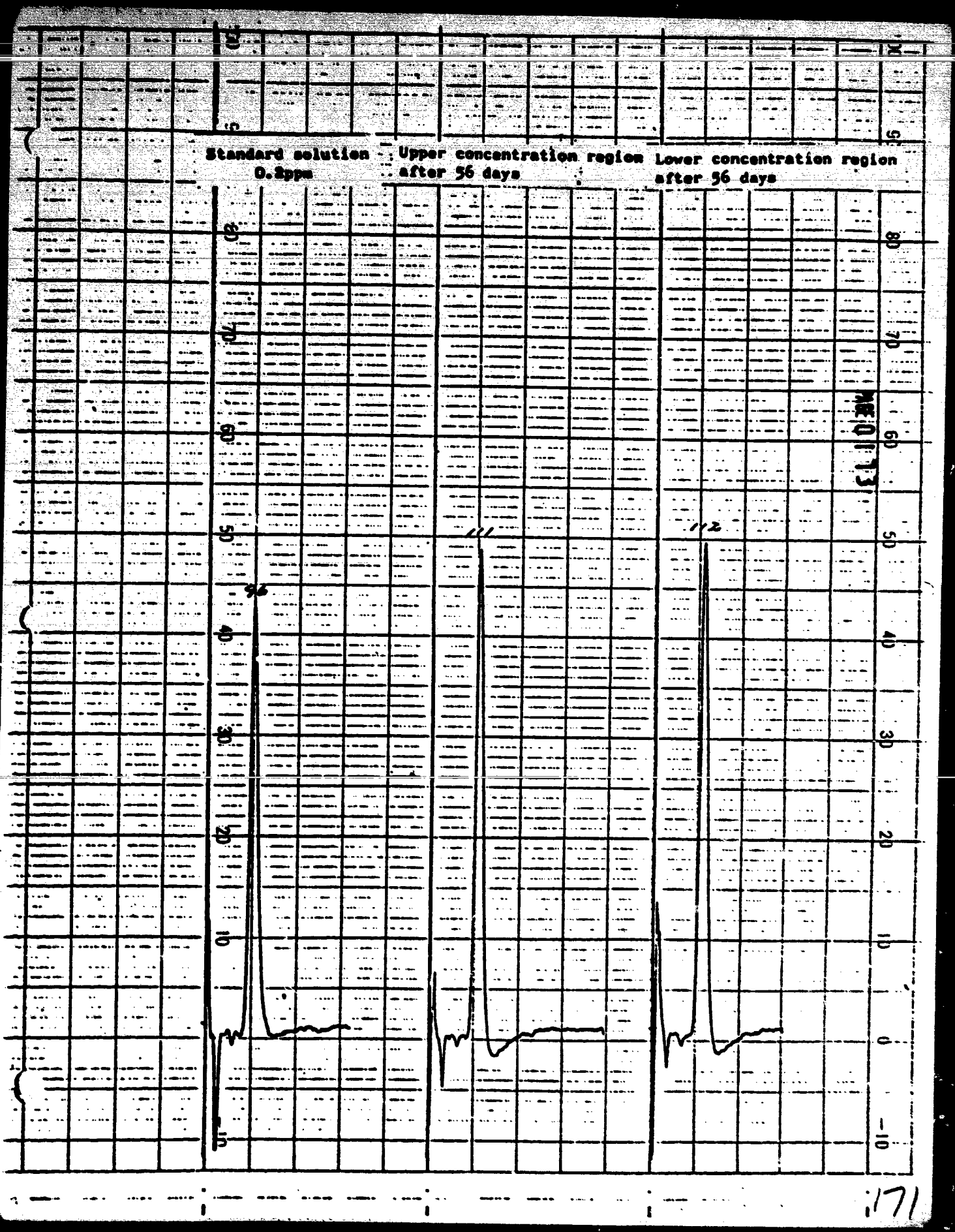
Operator A Group



PAGE 0 1 10


The figures above each peak show the peak height (mm)
Upper concentration region after 34 days
Lower concentration region after 34 days
Standard solution 0.2ppm
102
114
105


ward solution
(2ppm
Upper concentration region
after 41 days
Lower concentration region
after 41 days
Standa
111
112
170


Standard solution
0.2ppm
Upper concentration region
after 56 days
Lower concentration region
after 56 days
80
70
60
50
40
30
20
10
0
-10
96
111
112

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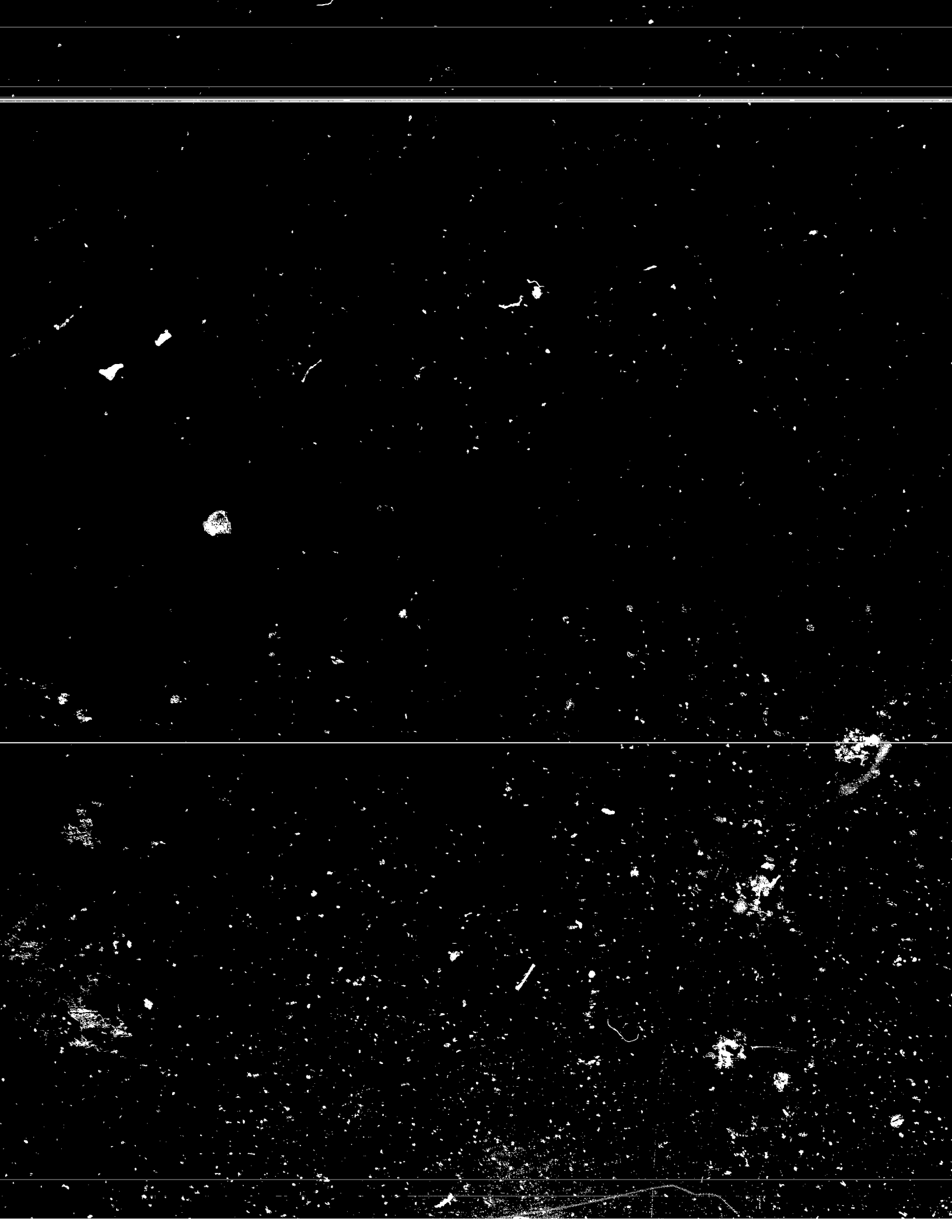
0143



88-7800184

8EHQ-0678-0184 (F)

International Research and Development Corporation

SPONSOR: Velsicol Chemical Corporation

TEST MATERIAL: CN-110-109

STUDY NUMBER: 163-502

SUBJECT: Acute Toxicity Studies in Rabbits and Rats.

PAGE 0390

1. The absence of primary skin irritation does not indicate the potential for sensitization or haloacne.
2. The dermal toxicity study in Rabbits has little significance.
3. This is a mixture containing significant amounts of at least one (possibly 2) [tribromophenol + vinyl ester). The rat study is therefore difficult to evaluate. From the data presented in other 018A submissions the ~~possi~~ probability is that deaths during the 1st 3 days were due to substances other than FM 680.

Joseph Seifter
8-9-78

Wilson P. Dean, B.A.
Director of Acute Toxicology
and Special Studies

Approved by: D. Clifford Jessup, Ph.D.
Associate Director of Research

Date: December 22, 1977

[redacted]

163-502

Declassified 8-22-78

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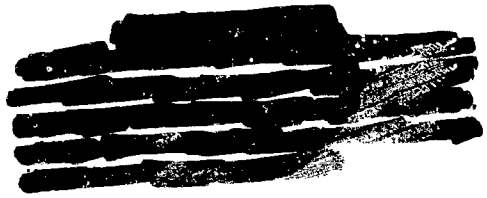

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0145

I. SYNOPSIS

Primary Eye Irritation Study in Rabbits

Not a primary eye irritant.

Primary Skin Irritation Study in Rabbits

Primary Irritation Score = 0.6
Not a primary skin irritant.

Acute Dermal Toxicity Study in Rabbits

The minimum lethal dose by the dermal route of administration was found to be greater than 200 mg/kg.

Acute Oral Toxicity (LD_{50}) Study in Rats

Male Rats: 1380 (1148 - 1660) mg/kg.
Female Rats: 1659 (1324 - 2079) mg/kg.
Combined Male and Female Rats: 1514 (1302 - 1759) mg/kg.

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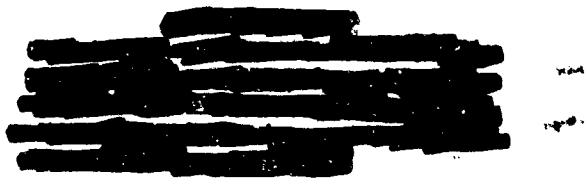
[redacted]

II. TEST MATERIAL

The test material was received from Velsicol Chemical Corporation, Chicago, Illinois on July 12, 1977. It was identified as "CN-110-109" and was received as a brown solid.

PR 0393



PART 0394

III. PRIMARY EYE IRRITATION STUDY IN RABBITS

A. METHOD:

Three male and 3 female New Zealand White rabbits (obtained from Kuiper's Rabbit Ranch, Gary, Indiana) were used for this study. The rabbits weighed from 2185 to 2525 grams at the beginning of the study. The rabbits were individually housed in metal metabolism cages in temperature and humidity controlled quarters. They were maintained in accordance with the recommendations contained in H.E.W. Publication No. 74-23 (N.I.H.) entitled "Guide for the Care and Use of Laboratory Animals". Water and Purina Rabbit Chow were available ad libitum.

Prior to test material administration, the eyes of each rabbit were examined with ultraviolet light following instillation of one drop of a 2.0 percent sodium fluorescein solution. Rabbits exhibiting corneal lesions were discarded.

The rabbits received 0.1 milliliter of the test material. The test material was placed into the cupped conjunctival sac of the right eye of each rabbit following which the eyelids were gently held together for one second. The left eye served as the untreated control for each rabbit. None of the rabbits received a washout.

[redacted]

The treated eyes were examined in accordance with the following schedule:

24 hours following instillation
48 hours
72 hours*
7 days*

*Sodium fluorescein examinations were conducted at these intervals. After grading the eye reaction, one drop of sodium fluorescein was instilled directly onto the corneal surface of each rabbit. After a few seconds, excess stain was flushed from the corneal surface with distilled water and the eyes examined with ultraviolet light.

The grading system employed in this test procedure is presented on page 5.

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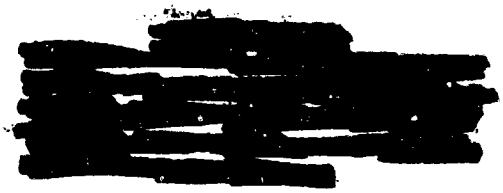

Scale for scoring ocular lesions

(1) Cornea

(A) Opacity-degree of density (area most dense taken for reading)

No opacity	0
Scattered or diffuse area, details of iris clearly visible	1
Easily discernible translucent areas, details of iris slightly obscured	2
Opalescent areas, no details of iris visible, size of pupil barely discernible	3
Opaque, iris invisible	4

(B) Area of cornea involved

One quarter (or less) but not zero	1
Greater than one quarter, but less than half	2
Greater than half, but less than three quarters	3
Greater than three quarters, up to whole area	4

Score equals A x B x 5 Total maximum = 80

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(2) Iris

(A) Values

Normal	0
Folds above normal, congestion, swelling, circumcorneal injection (any or all of these or combination of any thereof) iris still reacting to light (sluggish reaction is positive)	1
No reaction to light, hemorrhage, gross destruction (any or all of these)	2

Score equals A x 5 Total maximum = 10

(3) Conjunctivae

(A) Redness (refers to palpebral and bulbar conjunctivae exluding cornea and iris)

Vessels normal	0
Vessels definitely injected above normal	1
More diffuse, deeper crimson red, individual vessels not easily discernible	2
Diffuse beefy red	3

(B) Chemosis

No swelling	0
Any swelling above normal (includes nictitating membrane)	1
Obvious swelling with partial eversion of lids	2
Swelling with lids about half closed	3
Swelling with lids about half closed to completely closed	4

(C) Discharge

No discharge	0
Any amount different from normal (does not include small amounts observed in inner canthus of normal animals)	1
Discharge with moistening of the lids and hairs just adjacent to the lids	2
Discharge with moistening of the lids and hairs, and considerable area around the eye	3

Score equals (A + B + C) x 2 Total maximum = 20

The maximum total score is the sum of all scores obtained for the cornea, iris, and conjunctivae. Total maximum score possible = 110.

---

*Draize, J. H., Appraisal of the Safety of Chemicals in Foods, Drugs, and Cosmetic, Assoc. Food and Drug Officials of the U. S., Austin, Texas; 1959, p. 51 [redacted] ording to revision in 1964. Edited by A. J. Lehman.

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[redacted]

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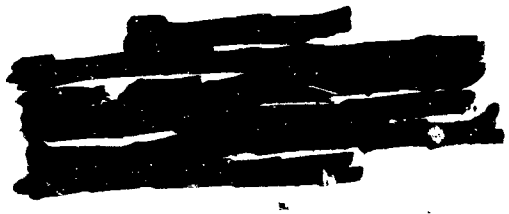
B. RESULTS:

Table 1 presents the grade of effect with time. Table 2 shows the average scores. Table 3 presents the individual rabbit scores.

Based upon the data, the test material would not be considered a primary eye irritant.

The test material would be further classified, based upon the scores obtained, as being mildly irritating to the eye when evaluated using the method described on page 7.

PAR 0397



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Classification of Test Materials Based on Eye Irritation Properties

Rating	Range	Definition
Non-Irritating	0.0 - 0.5	To maintain this rating, all scores at the 24-hour reading must be zero; otherwise, increase rating one level.
Practically Non-Irritating	Greater than 0.5 - 2.5	To maintain this rating, all scores at the 24-hour reading must be zero; otherwise, increase rating one level.
Minimally Irritating	Greater than 2.5 - 15.0	To maintain this rating, all scores at the 72-hour reading must be zero; otherwise, increase rating one level.
Mildly Irritating	Greater than 15.0 - 25.0	To maintain this rating, all scores at the 7-day reading must be zero; otherwise, increase rating one level.
Moderately Irritating	Greater than 25.0 - 50.0	To maintain this rating, scores at 7 days must be less than or equal to 10 for 60% or more of the animals. Also, mean 7-day score must be less than or equal to 20. If 7-day mean score is less than or equal to 20 but less than 60% of animals show scores less than 10, then no animal among those showing scores greater than 10 can exceed a score of 30 if rating is to be maintained; otherwise, increase rating one level.
Severely Irritating	Greater than 50.0 - 80.0	To maintain this rating, scores at 7 days must be less than or equal to 30 for 60% or more of the animals. Also, mean 7-day score must be less than or equal to 40. If 7-day mean score is less than or equal to 40 but less than 60% of the animals show scores less than or equal to 30, then no animal among those showing scores greater than 30 can exceed a score of 60 if rating is to be maintained, otherwise, increase rating one level.
Extremely Irritating	Greater than 80.0 - 110.0	[redacted]

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CN-110-109: Eye Irritation in the Albino Rabbit.

TABLE 1. Group Observations.

	Observations		Examination Interval (No. Positive/No. Dosed) Hours 24	48	72	Days 7
Cornea:	Cornea normal		3/6	4/6	6/6	6/6
	Dulling normal corneal luster		3/6	2/6		
	Corneal opacity:	very slight				
		slight				
		moderate				
		marked				
Iris:	Iris normal		5/6	6/6	6/6	6/6
	Iridal irritation		1/6			
Conjunctivae:	Redness:	normal	1/6	2/6	5/6	6/6
		very slight	3/6	3/6		
		slight	2/6	1/6	1/6	
		moderate				
		marked				
	Chemosis:	normal	2/6	1/6	5/6	6/6
		very slight	4/6	5/6	1/6	
		slight				
		moderate				
		marked				
	Discharge:	normal	6/6	6/6	6/6	6/6
		very slight				
		slight				
		moderate				
		marked				
	Purulent Discharge:					
Sodium Fluorescein/ Ultraviolet light examination:	Negative: (normal)		---	---	6/6	6/6
	Positive: (corneal injury)		---	---	0/6	0/6
Other:						
Corneal Epithelial Damage, Peeling			3/6	1/6	0/6	0/6

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[redacted]

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CM-110-109: Eye Irritation in the Albino Rabbit.

TABLE 2. Group Average Scores.

		Average Scores (Range)			
		Period			
		Hours			Days
Area:		24	48	72	7
Cornea:	A	0	0	0	0
	B	0	0	0	0
	Score	0	0	0	0
Iris:	A	0.2 (0-1.0)	0	0	0
	Score	1.0	0	0	0
Conjunctivae:	A	0.6 (0-1.0)	0.4 (0-1.0)	0.2 (0-1.0)	0
	B	0.4 (0-1.0)	0.5 (0-1.0)	0.1 (0-0.5)	0
	C	0	0	0	0
	Score	2.0	1.8	0.6	0
Total Score:		3.0	1.8	0.6	0

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[redacted]

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CN-110-109: Eye Irritation in the Albino Rabbit.

TABLE 3. Individual Rabbit Scores.

Area			Rabbit Number 28926, Female Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	0	0	0	0
	Subtotal	(A x 5)	0	0	0	0
Conjunctivae:	Redness	(A)	1.0	1.0	1.0	0
	Chemosis	(B)	1.0	0.5	0	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	4.0	3.0	2.0	0
Total Score:			4.0	3.0	2.0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative

Other:

Corneal Epithelial Damage, Peeling	X
Dulling of the Corneal Surface	X

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[redacted]

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[redacted]-110-108: Eye Irritation in the Albino Rabbit.

TABLE 3. (Cont.) Individual Rabbits Scores.

Rabbit Number 28952, Female

Area			Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	0	0	0	0
	Subtotal	(A x 5)	0	0	0	0
Conjunctivae:	Redness	(A)	1.0	0	0	0
	Chemosis	(B)	0.5	0	0	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	3.0	0	0	0
Total Score:			3.0	0	0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative
Other:						
Corneal Epithelial Damage, Peeling			X	X		
Dulling of the Corneal Surface			X	X		

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[redacted]

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TABLE 3. (Cont.) Individual Rabbit Scores.

Rabbit Number 28953, Male

Area			Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	0	0	0	0
	Subtotal	(A x 5)	0	0	0	0
Conjunctivae:	Redness	(A)	0	0	0	0
	Chemosis	(B)	0	0.5	0.5	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	0	1.0	1.0	0
Total Score:			0	1.0	1.0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative

Other:

Corneal Epithelial Damage, Peeling	X	
Dulling of the Corneal Surface	X	X

[redacted]

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TABLE 3. (Cont.) Individual Rabbit Scores.

Rabbit Number 28958, Female

Area			Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	0	0	0	0
	Subtotal	(A x 5)	0	0	0	0
Conjunctivae:	Redness	(A)	0.5	0.5	0	0
	Chemosis	(B)	0.5	0.5	0	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	2.0	2.0	0	0
Total Score:			2.0	2.0	0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative

[redacted]

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CN-110-109: Eye Irritation in the Albino Rabbit.

TABLE 3. (Cont.) Individual Rabbit Scores.

Area			Rabbit Number 28959, Male Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	0	0	0	0
	Subtotal	(A x 5)	0	0	0	0
Conjunctivae:	Redness	(A)	0.5	0.5	0	0
	Chemosis	(B)	0.5	0.5	0	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	2.0	2.0	0	0
Total Score:			2.0	2.0	0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative

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CM-110-109: Eye Irritation in the Albino Rabbit.

TABLE 3. (Cont.) Individual Rabbit Scores.

Area			Rabbit Number 28977, Male Observations: Hours 24	Hours 48	Hours 72	Days 7
Cornea:	Opacity	(A)	0	0	0	0
	Area	(B)	0	0	0	0
	Subtotal	(A x B x 5)	0	0	0	0
Iris:	Irritation	(A)	1.0	0	0	0
	Subtotal	(A x 5)	5.0	0	0	0
Conjunctivae:	Redness	(A)	0.5	0.5	0	0
	Chemosis	(B)	0	1.0	0	0
	Discharge	(C)	0	0	0	0
	Subtotal	(A + B + C)x2	1.0	3.0	0	0
Total Score:			6.0	3.0	0	0
Sodium Fluorescein Exam:			---	---	Negative	Negative

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[redacted]

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IV. PRIMARY SKIN IRRITATION STUDY IN RABBITS

A. METHOD:

Three male and 3 female New Zealand White rabbits (obtained from Kuiper's Rabbit Ranch, Gary, Indiana) were used for this study. The rabbits weighed from 2110 to 2570 grams at the beginning of the study. They were individually housed in metal metabolism cages in temperature and humidity controlled quarters. They were maintained in accordance with the recommendations contained in H.E.W. Publication No. 74-23 (N.I.H.) entitled "Guide for the Care and Use of Laboratory Animals". Water and Purina Rabbit Chow were available ad libitum.

The hair was removed from the back of each rabbit with an electric clipper. The skin of 3 of the rabbits was abraded with a scalpel blade. The abrading was not sufficiently deep to cause bleeding.

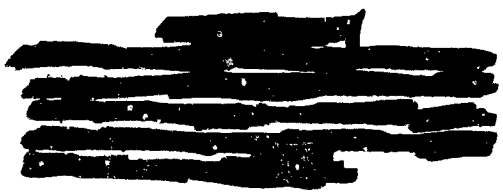
Five hundred milligrams of the test material was applied to the back of each rabbit. The application sites were then covered with gauze bandaging and occluded with Saran Wrap. Four hours later the bandages were removed and the sites were washed with tepid tap water and examined for skin irritation in accordance with the attached scale. These examinations were repeated at 24, 48 and 72 hours.

B. RESULTS:

The table on the following page presents the grade of effect with time. Table 4 presents the individual rabbit scores and the computed primary irritation score of 0.6.

Based upon the results obtained, CN-110 109 would not be considered a primary skin irritant.

The test material would be further classified, based upon the scores obtained, as being slightly irritating to the skin when evaluated using the method described on page 18.



Number of Animals Exhibiting Signs with Scoring "Value"

		Intact Skin				Abraded Skin			
		Hours				Hours			
Observations	Value	4	24	48	72	4	24	48	72
Erythema,	0		1/3	1/3	1/3				
Eschar	1	3/3	2/3	2/3	2/3	3/3	3/3	3/3	3/3
Formation	2								
	3								
	4								
Edema	0	1/3	3/3	3/3	3/3		3/3	3/3	3/3
Formation	1	2/3				3/3			
	2								
	3								
	4								

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[redacted]

Primary Skin Irritation Scoring Scale

	Value*
Erythema and Eschar Formation:	
No erythema	0
Very Slight erythema (barely perceptible)	1
Well defined erythema	2
Moderate to severe erythema	3
Severe erythema (beet redness) to slight eschar formation (injuries in depth)	4
Edema Formation:	
No edema	0
Very slight edema (barely perceptible	1
Slight edema (edges of area well defined by definite raising)	2
Moderate edema (raised approximately 1.0 mm)	3
Severe edema (raised more than 1.0 mm extending beyond the area of exposure)	4

Mean Primary Irritation Score Evaluation (Range of Values)	Descriptive Rating
0	Non-Irritating
0.1 - 0.5	Minimally Irritating
0.6 - 1.5	Slightly Irritating
1.6 - 3.0	Mildly Irritating
3.1 - 5.0	Moderately Irritating
5.1 - 6.5	Severely Irritating
6.6 - 8.0	Extremely Irritating

[redacted]

Individual Rabbit Scores and Score Calculation

CM-110-109:

TABLE 4. Intact Skin

Animal No./Sex	Erythema Observation Period (Hours) 4	24	48	72		Edema Observation Period (Hours) 4	24	48	72	
28964, Female	0.5	0.5	0.5	0.5		0	0	0	0	
28976, Female	0.5	0	0	0		0.5	0	0	0	
28987, Male	0.5	0.5	0.5	0.5		0.5	0	0	0	
Total	1.5	1.0	1.0	1.0		1.0	0	0	0	
Average (Value)	0.5	0.3	0.3	0.3		0.3	0	0	0	

PAGE 0410

Abraded Skin

Animal No./Sex	Erythema Observation Period (Hours) 4	24	48	72		Edema Observation Period (Hours) 4	24	48	72	
28809, Male	0.5	0.5	0.5	0.5		0.5	0	0	0	
28920, Female	1.5	1.0	1.0	0.5		0.5	0	0	0	
28927, Male	0.5	0.5	0.5	0.5		0.5	0	0	0	
Total	2.5	2.0	2.0	1.5		1.5	0	0	0	
Average (Value)	0.8	0.7	0.7	0.5		0.5	0	0	0	

Calculation for Primary Skin Irritation Score (Score = sum of the values (averages) divided by the number of observation periods used in evaluating the Primary Irritation Score times 2):
4.9 ÷ 8 = 0.6

163-502

[redacted]

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V. ACUTE DERMAL TOXICITY STUDY IN RABBITS

A. METHOD:

Five male and 5 female New Zealand White rabbits (obtained from Kuiper's Rabbit Ranch, Gary, Indiana) were used for this study. The rabbits weighed from 2305 to 2930 grams at the beginning of this study. They were individually housed in metal metabolism cages in temperature and humidity controlled quarters. They were maintained in accordance with the recommendations contained in H.E.W. Publication No. 74-23 (N.I.H.) entitled "Guide for the Care and Use of Laboratory Animals". Water and Purina Rabbit Chow were available *ad libitum*. Body weights were measured initially and at 7 and 14 days.

PAGE 0411

The hair was removed from the back of each rabbit (20-30% of the body surface) with an electric clipper. The skin of two male and three female rabbits was abraded with a scalpel blade. The abrasions penetrated the stratum corneum, but were not deep enough to cause bleeding.

The test material was applied once only to the backs of the rabbits at a dosage level of 200 mg/kg.

The area of application was wrapped with gauze bandaging and occluded with Saran Wrap. Twenty-four hours later the bandages were removed and the backs were washed with tepid tap water. They were observed at 24 hours and daily thereafter for a total of 14 days for mortality only.

B. RESULTS:

1. Mortality:

None of the rabbits died during the 14-day observation period.

The minimum lethal dose by the dermal route of administration was found to be greater than 200 mg/kg.

[redacted]

2. Body Weights:

The following body weights were obtained during the 14-day observation period:

Dosage Level (mg/kg)	Individual Rabbit No.	Sex	Control Weight (grams)	7-Day Weight (grams)	14-Day Weight (grams)
200	28745	Male	2305	2525	2727
	28747	Male	2500	2621	2794
	28895	Male	2630	2640	2716
	28897	Male	2625	2285	2499
	28983	Male	2500	2525	2545
	28704	Female	2555	2693	2696
	28760	Female	2930	2887	3100
	28822	Female	2670	2687	2840
	28886	Female	2495	2536	2657
	28894	Female	2555	2780	2978

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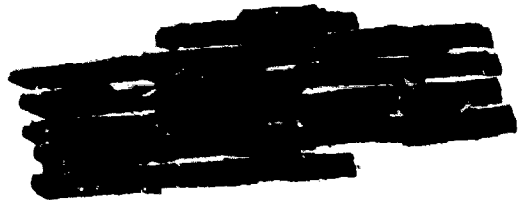


VI. ACUTE ORAL TOXICITY (LD_{50}) STUDY IN RATS

A. METHOD:

Thirty male and 30 female rats of the Charles River CD strain (obtained from Charles River Laboratories, Portage, Michigan), weighing from 200 to 223 grams, were used for this study. The rats were housed by sex in groups of 5 rats per cage, in hanging wire-mesh cages in temperature and humidity controlled quarters. They were maintained in accordance with the recommendations contained in H.E.W. Publication No. 74-23 (N.I.H.) entitled "Guide for the Care and Use of Laboratory Animals". Water and Purina Laboratory Chow were available ad libitum, except for an overnight period preceding oral administration during which food, but not water was withheld.

The test material was suspended in a 60% corn oil/40% acetone mixture and administered orally by gavage at the following dosage levels to male and female rats: 631, 1000, 1585, 2512, 3980 and 6308 mg/kg.

Five rats of each sex were used at each dosage level. Volumes of 10 ml/kg of body weight were administered at all dosage levels.

All rats were observed for mortality, only, during the first four hours after dosing, at 24 hours and daily thereafter for a total of 14 days.

Body weights were recorded initially and at 7 and 14 days.

[redacted]

B. **RESULTS:**

1. **Mortality and LD_{50} Values:**

Dose - Mortality Data

Dosage Level mg/kg	Number of Deaths: Hrs. 0-4		Days 1		2		3		4		5		6		7-14		Total Mortalities: Male	Female	Total
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F			
631																	0/5	0/5	0/10
1000																	0/5	0/5	0/10
1585					3		1	2									4/5	2/5	6/10
2512					5	5											5/5	5/5	10/10
3980			5	2		3											5/5	5/5	10/10
6308			5	4		1											5/5	5/5	10/10

The Acute Oral LD_{50} Values and 95% Confidence Limits

Male Rats: 1380 (1148 - 1660) mg/kg.
Female Rats: 1659 (1324 - 2079) mg/kg.
Combined Male and Female Rats: 1514 (1302 - 1759) mg/kg.

Slope

Male Rats: 1.67
Female Rats: 1.67
Combined Male and Female Rats: 1.67

Statistical References

[1] Weil, C. S. 1952. Tables for Convenient Calculation of Median Effective Dose and Instruction in Their Use. Biometrics, 8: 249-263.

[2] Thompson, W. R. and Weil, C. S. 1952. On the Construction of Tables for Moving Average Interpolation. Biometrics, 8: 51-54.

[3] Eby, R. 1957. Statistical Tables for Dose Evaluation, Report No. 5711. Miles-Ames Research Laboratory, Elkhart, Indiana.

[redacted]

2. Body Weights:

The following body weights were obtained during the 14-day observation period:

Dosage Level (mg/kg)	Individual Rat Number	Sex	Control Weight (grams)	7-Day Weight (grams)	14-Day Weight (grams)
631	63112	Male	210	264	310
	63113	Male	223	281	330
	63114	Male	213	26[illegible]	320
	63115	Male	215	257	304
	63116	Male	222	274	330
	63117	Female	200	215	250
	63118	Female	200	218	222
	63119	Female	200	223	228
	63120	Female	200	220	235
	63121	Female	200	209	233
1000	62859	Male	202	270	298
	62860	Male	212	265	317
	62861	Male	200	240	280
	62862	Male	216	275	317
	62863	Male	219	269	320
	62864	Female	201	215	248
	62865	Female	204	218	253
	62866	Female	207	220	274
	62867	Female	201	225	245
	62868	Female	200	211	241
1585	62869	Male	216	280	315
	62870	Male	212	Died	Died
	62871	Male	200	Died	Died
	62872	Male	205	Died	Died
	62873	Male	212	Died	Died
	62874	Female	224	Died	Died
	62875	Female	203	Died	Died
	62876	Female	201	260	252
	62877	Female	219	240	274
	62878	Female	201	230	243

[redacted]

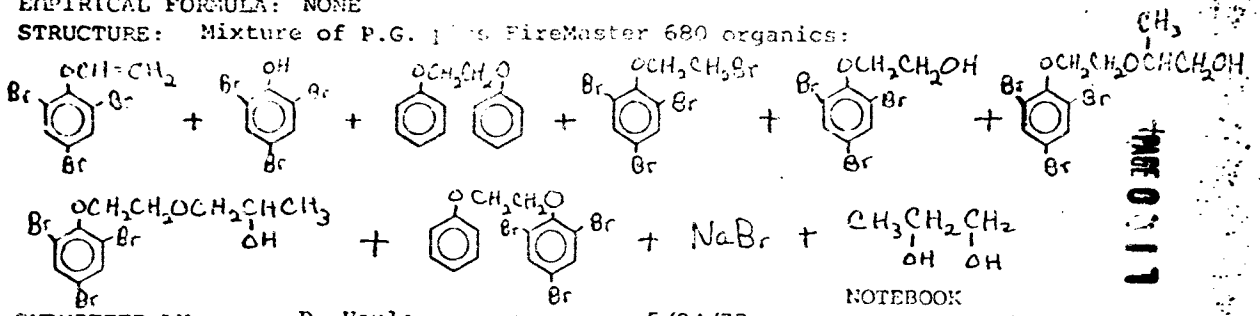
Dosage Level (mg/kg)	Individual Rat Number	Sex	Control Weight (grams)	7-Day Weight (grams)	14-Day Weight (grams)
2512	62879	Male	204	Died	Died
	62880	Male	200	Died	Died
	62881	Male	211	Died	Died
	62882	Male	212	Died	Died
	62883	Male	214	Died	Died
	62884	Female	207	Died	Died
	62885	Female	204	Died	Died
	62886	Female	200	Died	Died
	62887	Female	202	Died	Died
	62888	Female	202	Died	Died
3980	62889	Male	211	Died	Died
	62890	Male	200	Died	Died
	62891	Male	214	Died	Died
	62892	Male	215	Died	Died
	62893	Male	206	Died	Died
	62894	Female	201	Died	Died
	62895	Female	206	Died	Died
	62896	Female	212	Died	Died
	62897	Female	203	Died	Died
	62898	Female	205	Died	Died
6308	62899	Male	201	Died	Died
	62900	Male	205	Died	Died
	62901	Male	202	Died	Died
	62902	Male	200	Died	Died
	62903	Male	200	Died	Died
	62904	Female	201	Died	Died
	62905	Female	203	Died	Died
	62906	Female	207	Died	Died
	62907	Female	211	Died	Died
	62908	Female	209	Died	Died

[redacted]

VELSICOL CHEMICAL CORPORATION
COMPOUND DATA SHEET

COMPOUND NUMBER: CN-110-109
COMPOUND NAME: FireMaster 680 Oils

EMPIRICAL FORMULA: NONE
STRUCTURE: Mixture of P.G. plus FireMaster 680 organics:



PAGE 0-11

SUBMITTED BY: P. Houle DATE: 5/24/77 NOTEBOOK REFERENCE: 992-55

PROPERTIES:
PHYSICAL APPEARANCE: Semi-solid Oily Mass
MELTING POINT:_____°C, BOILING POINT:_____°C, SOFTENING POINT:_____°C
THERMAL STABILITY (CAPILLARY):
THERMAL ANALYSIS, TGA WT. LOSS: 5%_____°C, 25%_____°C, 50%_____°C
SOLUBILITY: ACETONE_____ HEXANE_____
BENZENE_____ WATER_____
ETHANOL_____ OTHER
ELEMENTAL ANALYSIS (THEORY): Br,_____%, Cl,_____%, P,_____%, OTHER_____
(FOUND): Br,_____%, Cl,_____%, P,_____%, OTHER_____
LIQUIDS ONLY: DENSITY_____ REFRACTIVE INDEX_____

APPLICATIONS REFERENCES: Toxicity testing

SAMPLE SIZE:

PURITY:

SYNTHETIC METHOD:

Organic oils obtained from FireMaster 680 process blow down of P.G. mother liquor - water is added to the P.G. mother liquor to remove organics prior to recovery of the P.G. via distillation.

LITERATURE REFERENCES (if any are known): [redacted]

CHEMICAL ABSTRACTS REGISTRY NUMBER:

CHEMICAL ABSTRACTS COMPOUND NAME:

D 1 7 1

INTER-OFFICE CORRESPONDENCE — VELSICOL CHEMICAL CORPORATION

DATE	January 13, 1978		COPIES TO	R. C. Nametz 714	MAIL NO.
				M. J. Onore	714
TO	F. A. Daniher	MAIL NO. 714		L. H. Hahn	714
				D. M. Whitacre	3322
				J. Baardsen	714
				C. J. Calo	3322
				H. V. Davis	5460
				T. R. Loy	3322
FROM	A. D. Fewless	MAIL NO. 714		A. A. Levin	4660
				M. S. Root	3322
SUBJECT	CN-110-109 - Analytical Data				

REGULATORY DIVISION JAN 18 1978 RECEIVED

PAGE 0410

Analytical data for a sample of fireMaster® 680 oils (992-55) have been obtained (requested by R. Nametz).

The analysis of this sample is as follows:

Component	Concentration (%)
1,2-propanediol	1.8
water	0.4
sodium bromide	0.1
vinyl tribromophenate	27.
2,4,6-tribromophenol	1.9
1,2-bis(phenoxy)ethane	ND (<0.1%)
2(2,4,6-tribromophenoxy)ethanol	25.
1-bromo-2(2,4,6-tribromophenoxy)ethane	1.7
1-phenoxy-2(2,4,6-tribromophenoxy)ethane	7.3
ethers of 1,2-propanediol and 1-bromo-2(2,4,6-tribromophenoxy)ethane	35.

If you have any questions, please contact me.

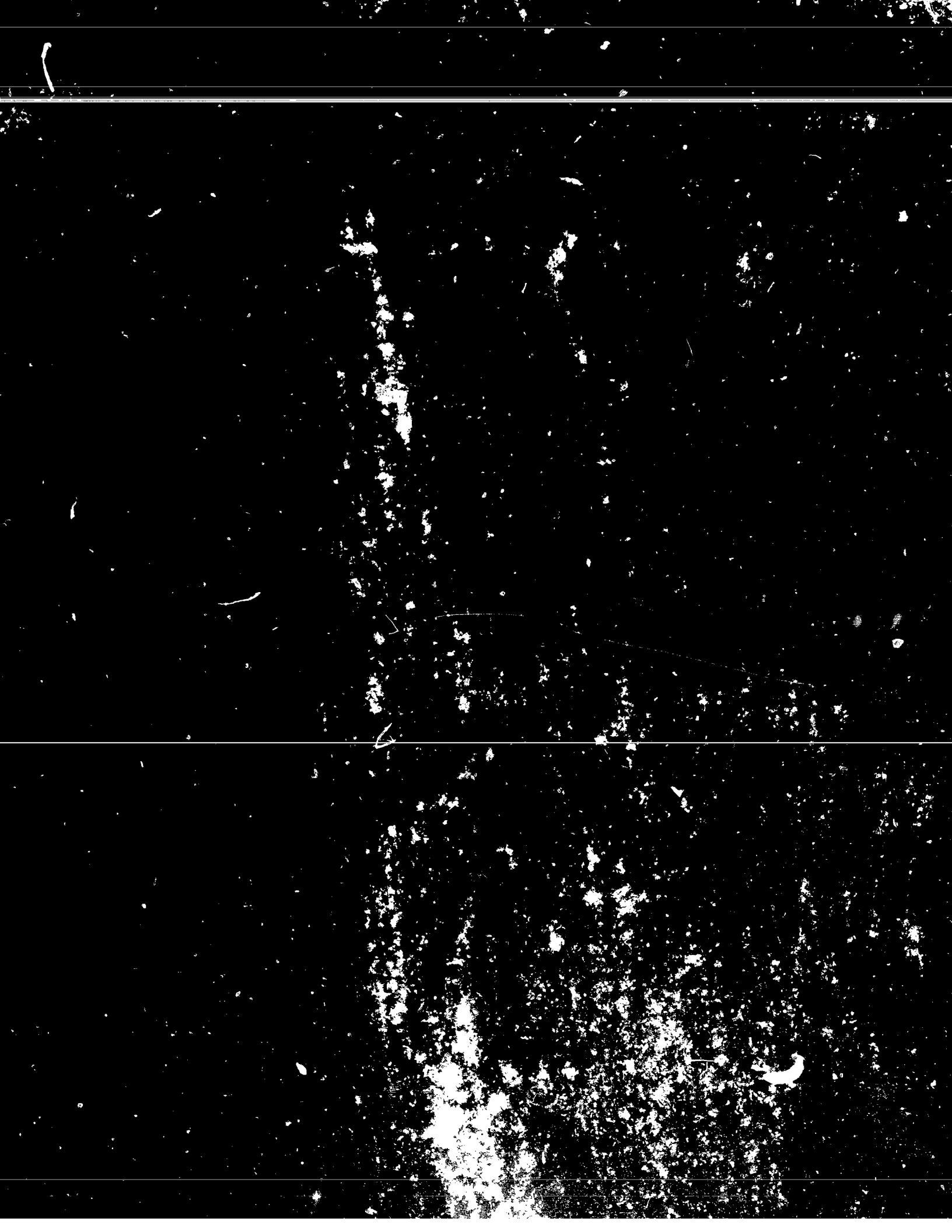
Allen D Fewless

Allen D. Fewless

ADF/jlw

204

0172



88-7800184 [redacted] WARF INSTITUTE, INC. 8EHQ-1278-0184 (G)

MADISON, WISCONSIN

Reports are submitted to clients on a confidential basis. No reference to the work, the results or to the Institute in any form of advertising, news release or other public announcement may be made without written authorization from the Institute.

REPORT

Sample: Firemaster 680 WARF No. 3042861

Submitted by: Richard Hametz
Michigan Chemical Corp
St. Louis, Mich.

Date Received: 4/26/73

MAR 0549

Testing requested:

Acute dermal LD 50 (1 level)

Conclusion:

Under the conditions specified the product has an acute dermal LD 50 in excess of 10 gm per kilogram body weight.

Signed [signature]

By and for WARF Institute Inc.

Date: June 14, 1973

file employees

[redacted]

[redacted]

Declassified
8-22-78

FORM 36 - 4

205

0173

Sample: Firemaster 680 WARF No. 3042861

Acute Dermal:

Method: Adult, male rabbits were employed. The animals were housed in individual screen-bottom cages and supplied with water and a commercial laboratory chow ad libitum. The test material was applied under a sleeve of rubber snugly fastened about the clipped trunk of the test animal. The animals were immobilized for a 24 hour period immediately following treatment. At the end of the exposure period the sleeves were removed and the animals returned to cages for a two week observation period during which evidences of toxicity were noted and mortality data tabulated.

Results:

Animal No.	Dose (gm/kg)	Body weight (gms) Initial	1 week	2 weeks
1	10	1593	[illegible]	[illegible]
2	10	1444	1616	1915

The acute dermal LD 50 is in excess of 10 gm/kg body weight.

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WARF INSTITUTE, INC.
PO Box 2599 506 North Walnut Street Madison Wisconsin 53701
Phone 608/257 4851

June 14, 1973

PAGE 0548

Mr. Richard C. Nemetz
Group Leader
Application Development
Michigan Chemical Corporation
500 North Bankson
St. Louis, Michigan 48880

Dear Mr. Nemetz:

Please find enclosed our corrected report on Fire-Master 680 as stated in your letter of June 11.

Thank you for bringing this to our attention, and we are sorry for any inconvenience this may have caused you.

Very truly yours,

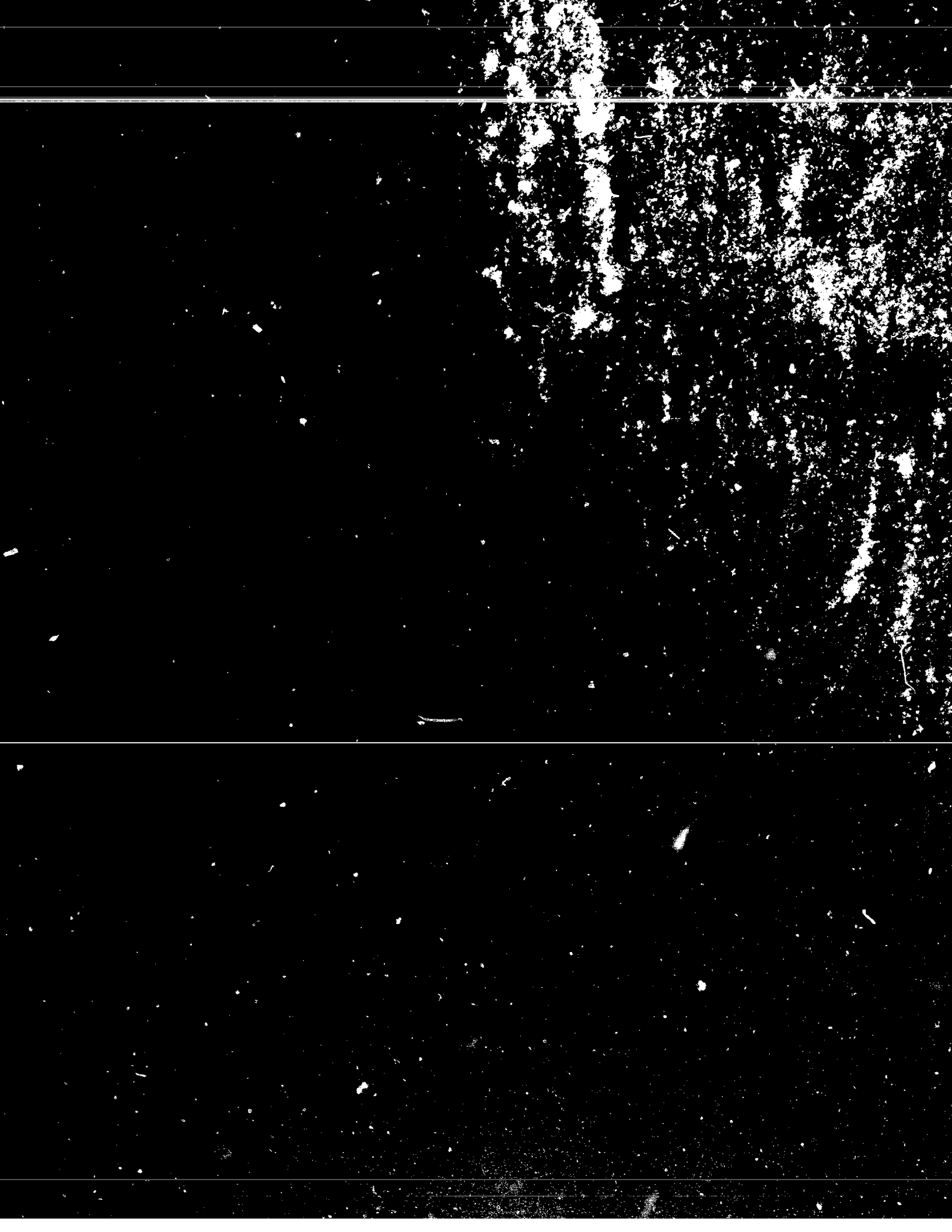
Leonard Regel
Biological Dept.

LR/sd
Enclosure

[redacted]

207

0175



88 7800184

8EHQ-0678 0184 (H)

International Research and Development Corporation

PAGE 0550

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680

SUBJECT: Acute Oral Toxicity Study in the Albino Rat.

In the absence of microscopic pathology data and evidence of absorption FM 680 cannot be considered to be non-toxic (page 1). The inhalation study (0184[0]) establish that absorbed 680 does not produce immediate effects but is stored in the body like DDT or PBB.
Joseph Seifter
Aug 9, 1978

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

[redacted]

Collaborator:

W. P. Dean

Date: November 27, 1974

134-011

Document declassified
8-22-78

[redacted]

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0176

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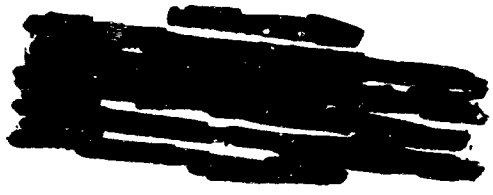

I. SYNOPSIS

Firemaster®680 was examined for acute oral toxicity in male and female albino rats at a dosage level of 10,000 mg/kg in both the non-micronized and the micronized forms.

None of the rats of either sex died at this dosage level when administered the non-micronized or micronized Firemaster®680.

Necropsy of the animals following the 14 day observation period, which received the mocronized Firemaster®680 material did not reveal any compound related findings.

Firemaster®680 would therefore not be considered a toxic material, in either the micronized or non-micronized form, by the oral route of administration.

[redacted]

II. COMPOUND

Two samples of the test compound were received from the Michigan Chemical Corporation, St. Louis, Michigan as follows:

Non-Micronized Sample: received on August 22, 1974. It was identified as "Firemaster® 680, Lot No. 761-7" and was received as a fine white powder.

Micronized Sample: received on September 19, 1974. It was identified as "Firemaster® 680, micronized material, from Lot 761-11" and was received as a fine white powder.

REF 04 21

III. ACUTE ORAL TOXICITY STUDY IN THE ALBINO RAT

A. METHOD:

Ten male and 10 female albino rats of the Spartan strain weighing from 212 to 250 grams were used in this study. The rats were housed by sex in groups of 5 rats each in cages elevated above the droppings. The animals were maintained in temperature and humidity controlled quarters throughout the study. Purina Laboratory Chow and water were available ad libitum except for an overnight period preceding compound administration during which food, but not water, was withheld.

The non-micronized and micronized samples of the test material was administered to 5 male and 5 female rats each at a dosage level of 10,000 mg/kg. The test compound was suspended in 0.5% Methocel and administered at a volume of 30 ml/kg. All rats were observed for mortality for a period of 14 days. Body weights were measured initially and at 14 days. All rats which received the micronized material were necropsied and subjected to a gross pathological examination following the 14 day observation period.

B. RESULTS:

None of the male or female rats receiving 10,000 mg/kg of either the micronized or non-micronized material died during the 14 day observation period.

All rats, both male and female, exhibited normal body weight gains during the study period.

A necropsy of the rats following the 14 day observation period, which received the micronized Firemaster® 680 material, failed to reveal any compound related findings. Two female rats exhibited hydrometra, a finding not uncommon in untreated control animals of this age and sex.

[redacted]

88-7800184 SE40-0780184 (I)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680, Lot No. 761-7

SUBJECT: Acute Oral Toxicity Study in Beagle Dogs.

PAGE 0423

no data in this submission
Joseph Gupter
Aug 9, 1978

Francis X. Wazeter, Ph.D.
President

[redacted]

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborator:

W. P. Dean

Date: November 27, 1974

[redacted]

134-012

Document declassified 8-22-78

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0181

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MRE 0128

[redacted]

0 1 8 2

I. SYNOPSIS

In an acute oral toxicity study in beagle dogs, Firemaster® 680, Lot No. 761-7 was administered by oral gavage at a dosage level of 10,000 mg/kg. Two male and two female dogs were used at this dosage level. Observations for pharmacodynamic signs and mortality were made frequent on the day of compound administration and daily thereafter for a total of 14 days.

No mortalities and no significant pharmacodynamic signs were obtained, either on the day of compound administration or during the 14 day observation period. Signs that were obtained are presented in the text of this report.

Based upon the results obtained, the acute oral toxicity of Firemaster® 680 would be greater than 10,000 mg/kg. Firemaster® 680, Lot No. 761-7 would not be considered a toxic substance by the oral route of administration.

[redacted]

II. COMPOUND

The test compound was received from Michigan Chemical Corporation, St. Louis, Michigan on August 22, 1974.

It was identified as "Firemaster® 680, Lot No. 761-7" and was received as a fine white powder.

[redacted]

III. METHOD

Two male and 2 female conditioned beagle dogs, weighing from 7.55 to 11.50 kilograms were used in this study. The dogs were housed individually in metal metabolism cages in temperature and humidity controlled quarters. Purina Chow for dogs and water were available ad libitum except for an overnight period preceding compound administration during which food, but not water, was withheld.

The two male and two female dogs were administered the test compound at a dosage level of 10,000 mg/kg. Firemaster®680, Lot No. 761-7 was suspended in 0.5% Methocel and administered by oral gavage. A rinse consisting of 20 ml of 0.5% Methocel was used following compound administration to each dog.

Each dog was observed for pharmacodynamic signs and mortality continuously from 0 to 5 hours, at 24 hours and daily thereafter for a total of 14 days.

Each dog was weighed prior to compound administration and at 14 days.

[redacted]

This belongs to different report Corrected 8-10-90

IV. RESULTS

A. Pharmacodynamic Signs and Mortality:

No mortalities occurred in either sex, either on the day of compound administration, or during the subsequent 14 day observation period.

No significant pharmacodynamic signs were observed in any of the dogs during the 14 day study period. Signs that were observed were limited to the following: white discolored feces in one female at 4-1/2 hours; in all four dogs at 24 hours; in one male and two females at 48 hours; and in one female at both 72 hours and 8 days. Soft feces was noted in one female at 24 hours. Lacrimation was noted in one male at 24 hours, and in one male and one female at 48 hours.

B. Body Weight:

No adverse effect on body weight was observed during the study period. Two males and one female maintained their body weights, while one female exhibited a body weight gain during the 14 day period of observation.

V. ACUTE ORAL TOXICITY IN THE BEAGLE DOG

Based upon the results obtained, the acute oral toxicity of Firemaster® 680 would be greater than 10,000 mg/kg. Firemaster®680, Lot No. 761-7, would not be considered a toxic substance by the oral route of administration.

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88 7800184 SI-49-0678-0104 (J)

International Research and Development Corporation

PAGE 0428

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680, micronized material

SUBJECT: Acute Inhalation Toxicity in the Albino Rat.

1. No controls
2. Inadequate necropsy
3. Indicates only that no immediate dramatic effects such as convulsions, odd behavior or death will follow exposure to Firemaster 680 dusts

Joseph Cuffer
Aug 8, 1978

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

[redacted]

Collaborator:

W. P. Dean

Date: November 27, 1974

[redacted]

134-013

Document declassified 8-22-78

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0187

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	B. Acute Inhalation Toxicity	4

[redacted]

I. SYNOPSIS

Firemaster®680, micronized material, was evaluated for acute inhalation toxicity in albino rats. No deaths occurred during the 4 hour exposure period or during the subsequent 14 day period of observation.

The pharmacodynamic and/or toxic signs observed are recorded in the body of this report.

Necropsy of the rats used in this study, following the 14 day observation period, failed to reveal any compound related findings.

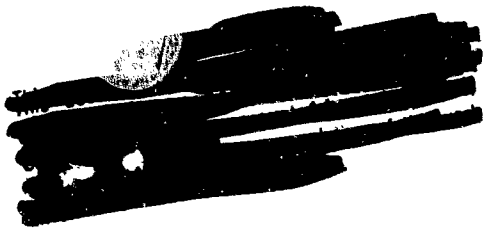
Based upon the results obtained, the acute inhalation toxicity in albino rats for Firemaster®680, micronized material, is greater than 36.68 mg/L.

[redacted]

II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on September 19, 1974. It was identified as "Firemaster®680, micronized material from Lot No. 761-11" and was received as a fine white powder.

MRD 0431



PAGE 0432

III. METHOD

A. General Procedure:

Five male and 5 female rats of the Spartan strain, weighing from 200 to 244 grams, were used in this test. The rats were housed by sex in groups of 5 in metal cages above the droppings and maintained in temperature and humidity controlled quarters throughout the pre-exposure and post-exposure period. Purina Laboratory Chow and water were available *ad libitum*.

During the 4 hour exposure to the test compound, the rats were observed continuously for changes in behavior and/or appearance. Immediately following the exposure, the rats were examined closely for pharmacodynamic and/or toxic signs. All rats which died on study and any survivors were subjected to a gross necropsy examination. The rats were observed for a period of 14 days and then sacrificed.

All rats were weighed just prior to the initiation of the exposure period and again at 14 days.

B. Compound Administration:

The group of 10 rats was placed in a [redacted] and exposed for 4 hours to a dynamic atm[redacted] dust of the test material. In order to prevent "piling up" during the exposure, the rats were separated into 4 units of 2 or 3 rats each.

Addition of the test compound to the test chamber atmosphere was controlled by a Wright Dust Feeder. Dried and filtered air was passed through the mechanism and directly into the exposure chamber. Airflow was regulated by means of a flowmeter[1].

The calculated atmospheric concentration administered was approximately 36.68 mg/L.* of Firemaster® 680, micronized material.

---

[1]Gelman Instrument Company, Ann Arbor, Michigan, Model No. 8221

*The physical properties of the test compound precluded the administration of the test material at a higher atmospheric concentration.

IV. RESULTS

A. Pharmacodynamic Signs:

All of the rats exposed to the 36.68 mg/L* atmospheric concentration of Firemaster®680, micronized material, survived the 4 hour exposure period, and also the subsequent 14 day observation period.

Signs seen during the 4 hour exposure period included increased followed by decreased motor activity, eye squint, erythema, slight dyspnea, slight bradypnea, salivation and nasal porphyrin discharge

At 24 hours and for the duration of the 14 day study period, all rats appeared normal, with the exception of one rat that exhibited nasal porphyrin discharge on both 7 and 8 days.

All rats exhibited normal body weight gains during the study period.

B. Necropsy Findings:

A necropsy of the rats following the 14 day observation period failed to reveal any compound related findings. Three rats exhibited greyish foci in the lungs, a finding not considered significant in rats of this age and strain.

C. Acute Inhalation Toxicity:

Based upon the results obtained, the acute inhalation toxicity in albino rats for Firemaster®680, micronized material is greater than 36.68 mg/L*.

---

*The physical properties of the test compound precluded administration of the test material at a higher atmospheric concentration.

88-7800184 8EHQ-0678-0184 (K)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680, Lot No. 761-7

SUBJECT: Acute Toxicity (TL_{50}) Study in the Bluegill.

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

[redacted]

Collaborator:

W. P. Dean

Date: December 13, 1974

134-014

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[redacted]

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MRID 01436

[redacted]

0 1 9 4

I. SYNOPSIS

An acute toxicity (TL_{50}) study in Bluegill was conducted using Firemaster©680 as the test material. Based upon the results obtained, the following (TL_{50}) values were derived:

24 hours: greater than 3160 mg/liter

48 hours: 1977 (1734-2256) mg/liter

96 hours: 1531 (1317-1780) mg/liter

[redacted]

II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on October 17, 1974. It was identified as "Firemaster® 680, Lot No. 761-7" and was received as a white powder.

[redacted]

III. ACUTE (TL_{50}) STUDY IN BLUEGILL

A. Method:

Eighty Bluegill fish obtained from a commercial bluegill producer in Brady, Nebraska, were used in this study. The fish had a mean weight of 1.40 grams and a mean length of approximately 50 mm.

The test fish were conditioned in the laboratory facilities for 21 days prior to testing, and were maintained on a standard fish food diet (PR-6, Glencoe Mills). During that period, mortality in the test population was less than 5 percent. No fish from the test group succumbed during the 8 day period immediately preceding the initiation of the test procedure. Fish selected for the bioassay were judged to be in an excellent state of health.

The bioassay was conducted in 5 gallon glass bioassay jars which were held in a constant temperature (± 0.5°C) water bath. The bluegill were tested at 18°C.

The test water consisted of 16 liters of deionized water of at least 1 million ohms resistivity. The test water was reconstituted by adding the following per liter of water:

3 mg potassium chloride
30 mg calcium sulfate
30 mg magnesium sulfate
48 mg sodium bicarbonate

The pH of the test water was 7.0. The test water was aerated immediately prior to the filling of the jars and placing of the test fish into the bioassay containers.

[redacted]

MRF 0438

A single introduction of the test material was made and the toxicity evaluated at 24 hour intervals for a total of 96 hours.

Fish used were of approximately the same weight and length (± 20%). The fish were conditioned to the test (reconstituted) water over a 4 day period. The fish were not fed for a 3 day period prior to the initiation of the bioassay nor were they fed during the 96 hour study period.

The test material was suspended in reconstituted water, by sonification, in concentrations enabling the constant administration of 1 ml of the test material and diluent, per 16 liters of test water. Ten fish were used at each concentration. The mass/volume ratio did not exceed 1.0 gram of fish per liter of test water.

The test fish were placed in the bioassay jars 16 hours prior to the introduction of the test material.

Six concentrations of the test material were employed in a geometric progression, which allowed the calculation of a (TL_{50}). Two groups of 10 fish each were employed as negative (untreated) controls.

B. Results:

Based upon the results obtained, the acute toxicity (TL_{50}) for Firemaster® 680 in Bluegills was calculated to be as follows:

(TL_{50}) Value
(Confidence Limits)

24 hours: greater than 3160 mg/liter
48 hours: 1977 (1734-2256) mg/liter
96 hours: 1531 (1317-1780) mg/liter

There were no mortalities in the negative (untreated) control groups.

[redacted]

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0 1 9 8

Table 1 presents the (TL_{50}) values for 24, 48 and 96 hours and the observed percent mortalities for 24, 48, 72 and 96 hours.

Dissolved oxygen and pH were monitored during the test period. Dissolved oxygen levels were maintained above 5.0 mg/liter, aeration being conducted on the day prior to dosing, and at 48 and 72 hours; pH ranged from 6.5 to 7.5.

The behavioral pattern exhibited by the fish at each concentration tested was as follows:

Concentration mg/liter	Observation Period			
	24 hours	48 hours	72 hours	96 hours
464	normal	normal	normal	normal
681	9) normal 1) dead	normal	normal	normal
1000	normal	normal	9) normal 1) dead	9) normal
1470	normal	10) staying at bottom	4) staying at bottom 3) swimming in side-up position 2) lying on bottom 1) dead	3) swimming in side-up position 4) lying on bottom 2) dead
2150	5) swimming in side-up position 5) staying at bottom	2) swimming in side-up position 8) dead	2) swimming in side-up position	2) dead
3160	3) staying at bottom 3) swimming in side-up position 4) lying on bottom	1) swimming in side-up position 9) dead	1) dead	--------
Negative Control (1)	normal	normal	[redacted]	normal
Negative Control (2)	normal	normal	normal	normal

Firemaster® 680:

Table 1. Acute Toxicity (TL_{50}) of Firemaster® 680 to Bluegill at 24, 48 and 72 hours and Percent Mortality Observed at 24, 48, 72 and 96 hours.

(TL_{50}) Value* (Confidence Limits) (mg/liter)	
24 hours:	greater than 3160 mg/liter
48 hours:	1977 (1734-2256) mg/liter
96 hours:	1531 (1317-1780) mg/liter

Concentration mg/L.	Percent Mortality			
	24 hours	48 hours	72 hours	96 hours
464	0	0	0	0
681	10	10	10	10
1000	0	0	10	10
1470	0	0	10	30
2150	0	80	80	100
3160	0	90	100	100
Negative Control (1)	0	0	0	0
Negative Control (2)	0	0	0	0

*Statistical Reference:
Thompson, W. R., Bact. Rev., 11: 115-147, 1947 (Modified).

134-014

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88-7800184 8EHQ-0678-0184 (L)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680, Lot No. 761-7

SUBJECT: Acute Toxicity (TL_{50}) Study in the Rainbow Trout.

[redacted]

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborator:

W. P. Dean

Date: December 13, 1974

[redacted]

134-014

Document declassified 8-22-78

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[redacted]

I. SYNOPSIS

An acute toxicity (TL_{50}) study in Rainbow Trout was conducted using Firemaster® 680 as the test material. Based upon the results obtained, the following (TL_{50}) values were derived.

24 hours: greater than 3160 mg/liter

48 hours: 2612 (2491-2738) mg/liter

96 hours: 1410 (1215-1637) mg/liter

[redacted]

0 2 0 3

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II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on October 17, 1974. It was identified as "Firemaster® 680, Lot No. 761-7" and was received as a white powder.

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0 2 0 4

III. ACUTE (TL_{50}) STUDY IN RAINBOW TROUT

A. Method:

Eighty Rainbow Trout obtained from a commercial trout producer in Tacoma, Washington, were used in this study. The fish had a mean weight of 1.90 grams and a mean length of approximately 45 mm.

The test fish were conditioned in the laboratory facilities for 21 days prior to testing, and were maintained on a standard fish food diet (PR-6, Glencoe Mills). No fish from the test group succumbed during the 8 day period immediately preceding the initiation of the test procedure. Fish selected for the bioassay were judged to be in an excellent state of health.

The bioassay was conducted in 5 gallon glass bioassay jars which were held in a constant temperature (± 0.5°C) water bath. The trout were tested at 13°C.

The test water consisted of 16 liters of deionized water of at least 1 million ohms resistivity. The test water was reconstituted by adding the following per liter of water:

3 mg potassium chloride
30 mg calcium sulfate
30 mg magnesium sulfate
48 mg sodium bicarbonate

The pH of the test water was 6.2. The test water was aerated immediately prior to the filling of the jars and placing of the test fish into the bioassay containers.

[redacted]

A single introduction of the test material was made and the toxicity evaluated at 24 hour intervals for a total of 96 hours.

Fish used were of approximately the same weight and length (± 20%). The fish were conditioned to the test (reconstituted) water over a 4 day period. The fish were not fed for a 3 day period prior to the initiation of the bioassay nor were they fed during the 96 hour study period.

The test material was suspended in reconstituted water, using sonification, in concentrations enabling the constant administration of 1 ml of the test material and diluent, per 16 liters of test water. Ten fish were used at each concentration. The mass/volume ratio did not exceed 1.19 grams of fish per liter of test water.

The test fish were placed in the bioassay jars 16 hours prior to the introduction of the test material.

Six concentrations of the test material were employed in a geometric progression, which allowed the calculation of a (TL_{50}). Two groups of 10 fish each were employed as negative (untreated) controls.

B. Results:

Based upon the results obtained, the acute toxicity (TL_{50}) for Firemaster 680 in Rainbow Trout was calculated to be as follows:

	(TL_{50}) Value (Confidence Limits)
24 hours:	greater than 3160 mg/liter
48 hours:	2612 (2491-2738) mg/liter
96 hours:	1410 [redacted] mg/liter

There were no mortal[redacted] untreated) control groups.

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Table 1 presents the (TL_{50}) values for 24, 48 and 96 hours and the observed percent mortalities for 24, 48, 72 and 96 hours.

Dissolved oxygen and pH were monitored during the test period. Dissolved oxygen levels were maintained above 5.0 mg/liter, aeration being conducted on the day of dosing (just prior to the introduction of the test material) and at 48 hours; pH ranged from 7.0 to 7.5.

The behavioral pattern exhibited by the fish at each concentration tested was as follows:

Concentration mg/liter	Observation Period			
	24 hours	48 hours	72 hours	96 hours
464	normal	normal	normal	normal
681	normal	normal	normal	9) normal 1) swimming in side-up position
1000	normal	normal	normal	9) normal 1) dead
1470	normal	5) normal 5) swimming in side-up position	7) normal 3) swimming in side-up position	1) lying on bottom and increased gill movement 4) swimming in side-up position 5) dead
2150	5) normal 5) swimming or lying upside down on bottom	10) lying on bottom and increased gill movement	8) lying on bottom and increased gill movement 2) swimming or lying upside down on bottom	10) dead
3160	10) lying on bottom and increased gill movement	10) dead		
Negative Control (1)	normal	normal	normal	normal
Negative Control (2)	normal	normal	normal	normal

Firemaster® 680:

Table 1. Acute Toxicity (TL_{50}) of Firemaster® 680 to Rainbow Trout at 24, 48 and 72 hours and Percent Mortality Observed at 24, 48, 72 and 96 hours.

(TL_{50}) Value* (Confidence Limits)
(mg/liter)

24 hours: greater than 3160 mg/liter
48 hours: 2612 (2491-2738) mg/liter
96 hours: 1410 (1215-1637) mg/liter

Concentration mg/L.	Percent Mortality			
	24 hours	48 hours	72 hours	96 hours
464	0	0	0	0
681	0	0	0	0
1000	0	0	0	10
1470	0	0	0	50
2150	0	0	0	100
3160	0	100	100	100
Negative Control (1)	0	0	0	0
Negative Control (2)	0	0	0	0

*Statistical Reference:
Thompson, W. R., Bact. Rev., 11: 115-147, 1947 (Modified).

[redacted]

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MRID 04450

APPENDIX I

Acute Toxicity (TL50) Study in the Rainbow Trout with Firemaster® 680, Lot No. 761-7

Bromine Analysis

Bromine analysis was conducted for water samples collected from the bioassay test containers at 1 and 96 hours. The water samples were analyzed by Neutron Activation for bromine content. The values obtained are shown in the attached table.

Based upon the data obtained, bromine values markedly decreased during the 96 hour study period.

[redacted]

Firemaster® 680: Acute Toxicity (TL_{50}) Study in the Rainbow Trout.

TABLE	Bromine Content, ppm.	
Test Compound Concentration mg/L.	Analysis of Bromine in Bioassay Containers	
	1 Hour	96 Hours
Control	1.0	0.2
464	2.0	3.3
681	2.5	1.1
1000	15.5	2.8
1470	38.4	5.4
2150	10.6	2.5
3160	276.0	8.9

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80-1800184 8EHQ-0678-0184 (N)

International Research and Development Corporation

[redacted] 0460

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster 680

SUBJECT: Twenty-Eight Day Dermal Toxicity Study in Rabbits.

File anything's ~~I guess that~~ this is a lipid soluble halogenated compound that stores in fat. Too bad that the proposed analyses for storage were never carried out. Seifter July 5, 1978

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborators:

R. G. Geil, D.V.M., Director of Pathology
W. P. Dean

[redacted] the work

Date: February 11, 1975

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Document declassified 8-22-78

No [redacted]

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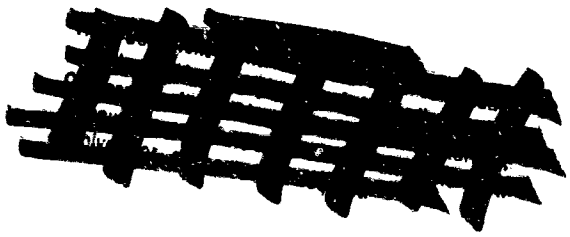

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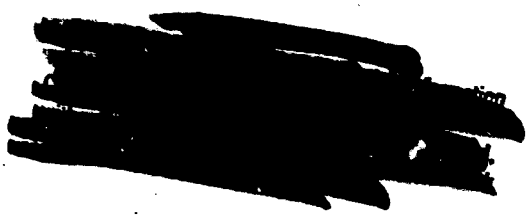

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1. SYNOPSIS

In a 28 day dermal toxicity study in New Zealand White rabbits, the test compound, Firemaster 680, was applied at dosage levels of 50, 500 and 5000 mg/kg/day, 5 days each week, for a total of 4 weeks. Three male and 3 female rabbits were used at each dosage level. A control group consisting of 3 male and 3 female rabbits received normal saline. The rabbits were observed daily for dermal and systemic toxicity. Body weights were obtained weekly throughout the study period. Clinical laboratory tests were performed once in the control period and at 14 and 28 days of study.

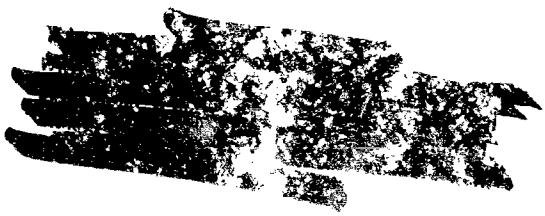
No clinical signs which were considered related to the application of the test compound were observed during the 28 day study period. None of the rabbits died during the study period.

The dermal irritation observed was limited to erythema which was evidenced in both the control and treated groups. This finding was attributed to the control vehicle, normal saline, and was not considered related to application of the test material.

Changes in body weight which occurred during the 28 day study period were not attributed to compound administration.

No compound related changes were observed in the hematological, biochemical or urinalysis studies conducted at 14 and 28 days.

No compound related gross or microscopic pathologic lesions or variations in organ weights were observed in any rabbits from the experimental groups.



II. COMPOUND

The compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on August 22, 1974.

It was identified as "Firemaster 680, Lot No. 761-7" and was received as a fine white powder.

[redacted]

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III. CLINICAL STUDIES

A. METHOD:

1. General Procedure:

Twelve male (weighing from 2730 to 3320 grams) and 12 female (weighing from 2176 to 3014 grams) New Zealand White rabbits were used in this study. The rabbits were housed individually in metal metabolism cages during the study. Pur[redacted] Rabbit Chow and water were available ad libitum.

The rabbits were acclimated for a period of 21 days prior to the initiation of the compound application period.

Following 28 days of study, all of the rabbits were sacrificed and necropsied. Tissues were collected for histopathology.

2. Compound Administration:

The compound was applied 5 days/week (total of 20 doses) at the dosage levels indicated below:

Number of Rabbits			
Male	Female	Dosage Level	
3	3	-	Control (normal saline)
3	3	50 mg/kg/day	Firemaster 680
3	3	500 mg/kg/day	Firemaster 680
3	3	5000 mg/kg/day	Firemaster 680

The dorsal skin of each rabbit (approximately 10% of the body surface) was shaved with electric clippers. The skin of one-half of the animals in each group was abraded twice weekly by producing shallow incisions (not sufficently deep to cause bleeding) with a scalpel blade. During the study the rabbits were abraded twice a week and shaved as necessary. The control rabbits received an equivalent volume of normal saline to that employed at the 5000 mg/kg/day dosage level.

The compound was evenly distributed with a glass rod. The rabbits were held immobile in wooden stocks during the 6 hour compound administration period following which the backs were washed with tepid tap water and the rabbits were returned to their individual cages. Individual daily doses were based upon the body weight obtained weekly.

3. Observations:

The rabbits were observed daily for changes in behavior and appearance and signs of systemic toxicity. Dermal observations were conducted prior to and following the 6 hour compound administration period (the scoring code employed for the dermal observations is shown on the following page). Individual body weights were obtained weekly during the control and study period.

4. Laboratory Tests:

Once in the control period and at 14 and 28 days of study, blood and urine samples were obtained from all rabbits for analysis.

a. Hematology:

Hematological studies included hemoglobin concentration[1], hematocrit[2], erythrocyte count[3], and total[3] and differential leucocyte counts.

b. Biochemistry:

Biochemical studies included plasma urea nitrogen[4], fasting plasma glucose[4], serum alkaline phosphatase[4] and serum glutamic oxalacetic and pyruvic transaminase activities[4].

c. Urinalysis:

Urinalysis included measurement of volume, pH[5] and specific gravity; description of color and appearance; and qualitative tests for

[redacted]

CODE

Erythema:

0 - None
1 - Very slight to slight
2 - Well defined or moderate
3 - Severe or marked

Eschar not graded only recorded name as necrosis, blanching, and hemorrhagic areas.

Edema:

0 - None
1 - Very slight to slight
2 - Moderate (raised 1.0 to 10 mm.)
3 - Marked (raised > 10.0 mm.)

Atonia:

1 - Slight (sl. impairment of elasticity)
2 - Moderate (slow return to normal)
3 - Marked (no elasticity)

Desquamation:

1 - Slight (slight scaling)
2 - Moderate (scales and flakes)
3 - Marked (pronounced flaking with denuded areas)

Leathery Texture:

1 - Slight (decrease in pliability)
2 - Moderate (leathery texture)
3 - Marked (tough and brittle)

Fissuring:

1 - Slight (definite cracks in epidermis)
2 - Moderate (cracks in dermis)
3 - Marked (cracks with bleeding)

albumin[5], glucose[5], occult blood[5] and bilirubin[5].

5. Bromine Analysis:

At terminal sacrifice samples of liver, fat, kidney, skin and blood were obtained from all animals for analysis by neutron activation for bromine content.

B. RESULTS:

1. General Behavior, Appearance and Survival:

No clinical signs which were considered related to compound application were observed during the study period.

Incidental findings included one rabbit (#20977, female, 500 mg/kg/day) which exhibited a clear nasal discharge or a thick white nasal discharge throughout the entire study period. One rabbit (#20976, male, 5000 mg/kg/day) showed diarrhea from the 4th through the 9th day of study and one rabbit (#20991, female, 5000 mg/kg/day) exhibited dehydration on the 4th and 5th days of study.

2. Dermal Irritation:

Rabbits in the control and each of the 3 treated groups exhibited very slight to slight erythema during the study period. One rabbit at the 5000 mg/kg/day dosage level exhibited very slight to moderate erythema. No significant difference was noted in the degree of erythema observed when comparing the observations made prior to and following each daily dermal application. No other signs of dermal irritation were observed during the study period.

Based upon the above findings, the erythema observed is considered attributable to the control vehicle (normal saline) and not to the application of the test material.

[redacted]

3. Body Weights (Table 1):

Changes in body weight during the 28 day study period were similar for the control and treated groups with the exception of one rabbit (#20976, male, 5000 mg/kg/day) which exhibited a 713 gram weight loss during the study period. It is significant to note that this rabbit showed a loss of 628 grams of body weight the first week of study and that from the 4th through the 9th day of study this rabbit exhibited diarrhea. Body weights obtained from this rabbit in the 2nd, 3rd and 4th weeks of study were essentially stable.

No changes in body weight which occured during the study period were attributed to the dermal application of Firemaster 680.

4. Clinical Laboratory Tests (Tables 2-4):

No compound related changes were observed in hematological, biochemical or urinalysis parameters which were obtained at 14 and 28 days of the study period.

5. Bromine Analysis:

The results obtained from analysis by neutron activation of samples of liver, fat, kidney, skin and blood obtained from animals at terminal sacrifice will be presented as Appendix I which will be forwarded immediately upon completion of the analyses.

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IV. PATHOLOGICAL STUDIES

A. METHODS:

1. Gross Pathology:

At the completion of the compound application period, all rabbits were sacrificed by intravenous air embolization and necropsied. Selected organs were weighed and representative tissues from each rabbit were collected in buffered neutral 10% formalin. Samples of liver, fat, kidney, skin and blood from all animals were collected and frozen for subsequent bromine analysis.

2. Histopathology:

The following tissues from each rabbit from the control and 5000 mg/kg/day groups were paraffin embedded, sectioned, stained with hematoxylin and eosin and examined microscopically:

brain	spleen	liver
peripheral nerve	lymph node	gallbladder
eye	thymus	kidneys
pituitary	bone marrow	urinary bladder
thyroid	stomach	testes/ovaries
adrenals	small intestine	skeletal muscle
lung	large intestine	skin
heart	pancreas	

Hematoxylin and eosin stained paraffin sections of skin, liver, kidney and bone marrow from rabbits from the 50 and 500 mg/kg/day dosage groups also were prepared and examined.

B. RESULTS:

1. Gross Pathology (Table 5) and Organ Weights (Table 6):

No compound related gross pathologic lesions or variations in organ weight were observed in any rabbits from the experimental groups.

2. Histopathology (Table 7):

No compound related microscopic lesions were observed in any tissues examined from any rabbits in the experimental groups.

[redacted]

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References

1. Cyanmethemoglobin Method, John B. Miale, 3rd Ed., 1967, The C. V. Mosby Company, p. 1143.
2. Microhematocrit, John B. Miale, 3rd Ed., 1967, The C. V. Mosby Company, p. 1154.
3. Coulter Particle Size Counter, Model A, Coulter Electronics, 590 W. 20th Street, Hialeah, Florida.
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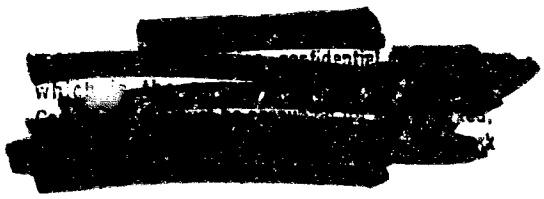
5. Bili-lab Stix (Ames Reagent Strips).



Firemaster 680: Twenty-eight Day Toxicity Study in Rabbits.

TABLE 1. Individual Weekly Body Weights, Grams.

Group, Rabbit No.	Sex	Control 1	Control 2	Control 3	Compound Administration Weeks 1	2	3	4
Control:								
20960	M	2747	2737	2837	2780	2790	2780	2755
20968	M	3032	2941	2948	2886	2789	2730	2695
20988	M	3022	3114	3075	3137	3125	3050	3045
20961	F	2815	2653	2691	2654	2770	2900	3025
20963	F	2686	2809	2966	2803	2958	3030	3120
20965	F	2487	2724	2760	2796	2770	2780	2915
50 mg/kg/day:								
20962	M	2812	3083	3117	3118	3225	3320	3355
20972	M	2938	3061	2730	2853	2974	3095	3180
20982	M	2528	2874	2925	3094	3076	3245	3275
20969	F	2636	2507	2500	2722	2622	2760	2830
20979	F	2477	2674	2739	2668	2687	2755	2755
20983	F	2915	2864	2997	2893	2973	2845	2985
500 mg/kg/day:								
20964	M	2892	3028	3178	3048	3148	3285	3235
20974	M	2733	2836	2900	2790	2871	2825	2855
20984	M	2596	2591	2776	2855	3051	3145	3230
20971	F	2650	2382	2548	2573	2775	2825	2950
20977	F	2714	2825	2533	2439	2602	2645	2705
20985	F	3026	3005	3014	2988	3079	3015	3110
5000 mg/kg/day:								
20976	M	2955	2974	2988	2360	2325	2260	2275
20978	M	3093	3188	3320	3340	3410	3475	3545
20980	M	3100	2933	3147	3214	3310	3320	3280
20987	F	2467	2689	2873	2894	2886	2885	2980
20989	F	2376	1972	2176	2383	2593	2655	2720
20991	F	2713	2534	2354	1948	2170	2210	2550

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Firemaster 680: [redacted] Twenty-eight Day Toxicity Study in Rabbits.

TABLE 2. [redacted] Hematological, Biochemical and Urinalysis Values - Control.

Group, Rabbit No.	Sex	Hematology: Total Erythrocytes 10⁶/cmm	Hemoglobin gm/100 ml	Hematocrit, %	Total Leucocytes 10³/cmm	Differential Count: Neutrophils, %	Seg., %	Non-Seg., %	Lymphocytes, %	Eosinophils, %	Monocytes, %	Basophils, %	Biochemistry: Glucose mg/100 ml	Urea Nitrogen mg/100 ml	Alkaline Phos. int'l units/ml	S.G.O.T. int/l units/ml	S.G.P.T. int'l units/ml	Urinalysis: Volume, ml	Color and appearance	Albumin	Glucose	Occult Blood	Bilirubin	Specific Gravity	pH
Control:																									
20960	M	5.05	10.5	36	8.78	22	22	0	76	2	0	0	110	17.3	116	20	11	30	Nor	N	N	N	N	1.03	7.8
20968	M	5.13	11.5	39	7.02	28	28	0	70	1	1	0	125	23.1	103	27	26	20	Nor	N	N	tr	N	1.03	8.3
20988	M	5.60	11.3	39	13.80	43	43	0	56	0	1	0	112	19.9	75	39	46	70	Nor	N	N	tr	N	1.01	8.3
20961	F	4.89	11.3	38	13.63	32	32	0	64	1	3	0	113	21.0	61	12	23	250	Nor	N	N	N	N	1.01	8.3
20963	F	5.18	11.0	35	7.81	33	33	0	65	2	0	0	111	29.9	95	19	39	300	Nor	N	N	N	N	1.02	8.0
20965	F	4.77	10.3	34	6.74	10	10	0	89	1	0	0	132	19.9	146	17	52	175	Nor	N	N	tr	N	1.02	7.9
50 mg/kg/day:																									
20962	M	5.64	11.9	41	8.06	37	37	0	69	0	1	0	113	19.5	111	21	32	75	Nor	N	N	N	N	1.03	8.5
20972	M	4.70	10.3	36	8.19	37	37	0	61	0	2	0	122	26.5	126	28	70	75	Nor	N	N	N	N	1.04	8.2
20982	M	4.64	9.6	33	7.14	35	35	0	64	0	1	0	124	12.9	85	27	52	55	Nor	N	N	N	N	1.02	8.3
20969	F	4.82	10.3	35	7.49	16	16	0	84	0	0	0	133	22.2	152	24	40	25	Nor	N	N	tr	N	1.04	8.0
20979	F	5.08	11.6	38	10.24	45	45	0	55	0	0	0	112	20.0	96	24	57	175	Nor	N	N	1+	N	1.02	7.9
20983	F	5.15	11.0	38	6.73	25	25	0	75	0	0	0	115	32.0	97	30	75	10	Nor	N	N	N	N	1.03	7.7
500 mg/kg/day:																									
20964	M	5.24	10.7	38	7.21	33	33	0	67	0	0	0	115	22.0	159	28	42	20	Nor	N	N	N	N	1.04	8.6
20974	M	5.64	11.8	42	6.46	30	30	0	68	2	0	0	120	23.8	110	50	40	30	Nor	N	N	4+	N	1.03	8.2
20984	M	4.82	10.3	37	11.10	22	22	0	76	1	1	0	119	20.5	104	20	40	40	Nor	N	N	N	N	1.04	8.2
20971	F	5.07	10.1	35	14.58	50	50	0	48	1	1	0	133	18.9	65	16	33	20	Nor	N	N	N	N	1.03	6.0
20977	F	5.52	11.9	40	8.33	44	44	0	53	1	2	0	109	26.9	105	25	46	50	Nor	N	N	N	N	1.03	6.2
20985	F	5.81	12.1	42	10.37	29	29	0	71	0	0	0	120	26.3	122	16	52	55	Nor	N	N	N	N	1.02	6.6
5000 mg/kg/day:																									
20976	M	5.80	12.6	43	9.48	23	23	0	77	0	0	0	125	20.9	103	24	40	35	Nor	N	N	N	N	1.03	6.3
20978	M	5.50	11.6	41	7.37	28	28	0	72	0	0	0	130	23.5	148	22	53	155	Nor	N	N	N	N	1.01	8.5
20980	M	5.15	10.5	35	7.26	25	25	0	74	0	1	0	117	15.1	85	18	48	35	Nor	N	N	N	N	1.04	7.9
20987	F	4.83	11.5	37	6.53	20	20	0	80	0	0	0	113	34.1	98	30	57	210	Nor	N	N	N	N	1.01	8.0
20989	F	4.70	10.3	33	8.57	31	31	0	69	0	0	0	130	16.2	35	18	38	15	Nor	N	N	N	N	1.01	7.4
20991	F	5.01	10.5	36	8.54	42	42	0	58	0	0	0	122	29.9	111	24	57	50	Nor	N	N	3+	N	1.04	7.1

Code: N - Negative; Nor - Normal; 1+ - Trace to slight; 2+ - Slight to moderate; 3+ - Moderate; 4+ - Marked

[redacted]

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Firemaster 680: [redacted] Twenty-eight Day Toxicity Study in Rabbits.

TABLE 3. [redacted] Hematological, Biochemical and Urinalysis Values - 14 Days.

Group, Rabbit No.	Sex	Hematology: Total Erythrocytes 10^6/cmm	Hemoglobin gm/100 ml	Hematocrit, %	Total Leucocytes 10^3/cmm	Differential Count: Neutrophils, %	Seg., %	Non-Seg., %	Lymphocytes, %	Eosinophils, %	Monocytes, %	Basophils, %	Biochemistry: Glucose mg/100 ml	Urea Nitrogen mg/100 ml	Alkaline Phos. int'l units/ml	S.G.O.T. int/l units/ml	S.G.P.T. int'l units/ml	Urinalysis: Volume, ml	Color and appearance	Albumin	Glucose	Occult Blood	Bilirubin	Specific Gravity	
Control:																									
20960	M	5.15	10.6	39	7.86	42	42	0	53	5	0	0	128	21.5	69	22	19	90	Nor	N	N	N	N	1.030	8.
20968	M	5.01	10.9	38	9.55	69	69	0	30	1	0	0	110	17.1	35	23	44	30	Nor	N	N	tr	N	1.045	9.
20988	M	5.61	11.3	40	11.93	55	55	0	42	2	1	0	95	19.7	41	16	40	200	Nor	N	N	1+	N	1.038	8.
20961	F	5.27	10.4	39	14.52	20	20	0	79	0	1	0	105	13.1	112	17	34	20	Nor	N	N	tr	N	1.033	8.
20963	F	5.06	10.3	35	10.55	37	37	0	60	3	0	0	106	25.0	50	23	55	45	Nor	N	N	N	N	1.036	8.
20965	F	4.22	8.4	33	8.13	52	52	0	45	2	1	0	105	20.2	51	10	30	20	Nor	N	N	tr	N	1.045	8.
50 mg/kg/day:																									
20962	M	5.55	11.6	40	6.13	22	22	0	76	2	0	0	112	15.1	75	16	30	18	Nor	N	N	N	N	1.048	9.
20972	M	4.66	10.6	34	6.83	15	15	0	84	1	0	0	120	16.0	82	26	55	40	Nor	N	N	N	N	1.045	7.
20982	M	5.10	10.6	39	6.24	52	52	0	46	2	0	0	104	18.1	61	15	37	40	Nor	N	N	tr	N	1.040	8.
20969	F	2.85	6.2	23	8.74	20*	20	0	80	0	0	0	120	17.5	74	38	36	70	Nor	N	N	N	N	1.055	8.
20979	F	5.13	10.1	36	11.21	65	65	0	35	0	0	0	110	18.9	54	19	56	45	Nor	N	N	1+	N	1.042	9.
20983	F	5.04	10.1	35	5.80	33	33	0	65	1	1	0	123	20.2	55	23	56	40	Nor	N	N	N	N	1.045	8.
500 mg/kg/day:																									
20964	M	5.25	10.2	37	7.77	20	20	0	80	0	0	0	116	16.4	96	28	52	60	Nor	N	N	N	N	1.035	8.
20974	M	5.66	11.3	41	6.14	36	36	0	62	2	0	0	136	20.0	74	28	25	15	Nor	N	N	N	N	1.037	9.
20984	M	4.99	10.3	39	7.88	24	24	0	76	0	0	0	104	15.6	126	37	43	65	Nor	N	N	tr	N	1.039	8.
20971	F	5.25	10.2	27	6.85	29	29	0	70	1	0	0	115	16.0	89	24	25	70	Nor	N	N	N	N	1.022	8.
20977	F	5.23	10.2	36	8.14	48	48	0	51	1	0	0	116	15.2	107	18	43	60	Nor	N	N	N	N	1.032	9.
20885	F	5.34	10.6	38	16.34	37	37	0	60	2	1	0	110	15.9	76	30	47	65	Nor	N	N	N	N	1.016	8.
5000 mg/kg/day:																									
20976	M	6.15	12.2	44	12.69	56	56	0	42	0	2	0,	135	14.2	56	16	25	60	Nor	N	N	1+	N	1.027	9.
20978	M	5.27	11.2	39	6.33	31	31	0	69	0	0	0	121	17.2	85	22	48	50	Nor	N	N	N	N	1.033	9.
20980	M	5.41	10.6	39	5.91	26	26	0	73	0	1	0	125	19.1	65	20	75	75	Nor	N	N	N	N	1.051	8.
20987	F	5.04	10.4	38	7.98	29	29	0	70	0	1	0	116	33.5	65	15	36	65	Nor	N	N	N	N	1.022	8.
20989	F	5.55	10.6	39	7.60	28	28	0	70	1	1	0	110	17.2	121	25	35	90	Nor	N	N	N	N	1.032	9.
20991	F	4.67	9.6	34	5.80	23	23	0	76	1	0	0	117	8.0	59	33	37	75	Nor	N	N	N	N	1.057	9.

Code: N - Negative; Nor - Normal; * - 2 polychromic, 2+ hypochromic, 4 nucleated erythrocytes/1000 WBC; 1+ - Trace to slight; 2+ - Slight to moderate; 3+ - Moderate; 4+ - Marked

[redacted]

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Firemaster 680: [redacted] Twenty-eight Day Toxicity Study in Rabbits.

TABLE 4. [redacted] Hematological, Biochemical and Urinalysis Values - 28 Days.

Group, Rabbit No.	Sex	Hematology: Total Erythrocytes 10^6/cmm	Hemoglobin gm/100 ml	Hematocrit, %	Total Leucocytes 10^3/cmm	Differential Count: Neutrophils, %	Seg., %	Non-Seg., %	Lymphocytes, %	Eosinophils, %	Monocytes, %	Basophils, %	Biochemistry: Glucose mg/100 ml	Urea Nitrogen mg/100 ml	Alkaline Phos. int'l units/ml	S.G.O.T. int/l units/ml	S.G.P.T. int'l units/ml	Urinalysis: Volume, ml	Color and appearance	Albumin	Glucose	Occult Blood	Bilirubin	Specific Gravity	pH
Control:																									
20960	M	4.53	10.6	35	8.29	51	51	0	49	0	0	0	135	20.0	50	15	24	30	Nor	N	N	4+	N	1.018	7.3
20968	M	4.80	11.6	35	6.69	53	53	0	43	3	1	0	96	18.5	39	19	46	120	Nor	N	N	4+	N	1.020	8.1
20988	M	4.92	11.0	35	14.13	62	62	0	37	0	1	0	126	15.1	39	11	40	85	Nor	N	N	3+	N	1.017	8.2
20961	F	4.96	11.4	37	8.42	35	35	0	62	2	1	0	125	15.0	138	21	27	135	Nor	N	N	tr	N	1.016	8.3
20963	F	5.38*	11.6	36	5.92	45	45	0	52	2	1	0	108	20.6	59	22	49	85	Nor	N	N	1+	N	1.026	7.9
20965	F	5.35	11.3	39	6.24	26	26	0	71	1	2	0	110	14.8	84	10	36	165	Nor	N	N	tr	N	1.010	8.4
50 mg/kg/day:																									
20962	M	5.26	12.5	39	6.00	30	30	0	68	0	2	0	121	12.9	67	40	63	80	Nor	N	N	1+	N	1.012	8.1
20972	M	4.42	10.5	33	6.72	11	11	0	89	0	0	0	131	13.1	88	25	47	80	Nor	N	N	N	N	1.022	8.0
20982	M	4.70	11.5	37	6.00	41	41	0	55	2	2	0	115	12.9	60	16	60	40	Nor	N	N	1+	N	1.029	8.1
20969	F	4.46	10.3	35	7.15	23	23	0	76	1	0	0	110	12.0	63	29	36	85	Nor	N	N	4+	N	1.021	8.0
20979	F	4.99	11.4	36	8.72	61	61	0	33	5	1	0	114	12.3	50	10	41	120	Nor	N	N	3+	N	1.025	8.1
20983	F	4.86	11.2	35	5.70	14	14	0	84	1	1	0	124	17.0	54	21	57	105	Nor	N	N	1+	N	1.026	8.0
500 mg/kg/day:																									
20964	M	5.05	11.9	38	11.06	43	43	0	53	3	1	0	135	14.0	67	12	49	40	Nor	N	N	1+	N	1.038	8.0
20974	M	5.52	11.6	39	8.37	67	67	0	33	0	0	0	156	17.2	60	17	34	65	Nor	N	N	4+	N	1.028	8.1
20984	M	4.88	11.5	37	7.01	16	16	0	82	1	1	0	105	13.5	119	14	43	175	Nor	N	N	3+	N	1.011	8.1
20971	F	5.40*	11.1	37	6.65	26	26	0	72	0	2	0	135	18.0	74	9	34	80	Nor	N	N	tr	N	1.017	7.9
20977	F	4.72	10.6	34	9.77	38	38	0	60	2	0	0	102	16.0	99	16	67	20	Nor	N	N	N	N	1.045	8.0
20985	F	4.92	11.3	35	14.89	54	54	0	43	1	2	0	113	12.9	72	14	58	200	Nor	N	N	2+	N	1.021	8.2
1000 mg/kg/day:																									
20976	M	4.97	11.0	36	9.67	67	67	0	32	0	1	0	112	11.0	34	23	29	35	Nor	N	N	2+	N	1.021	8.0
20978	M	5.01	11.7	37	9.43	18	18	0	78	2	2	0	131	12.9	60	17	45	130	Nor	N	N	N	N	1.010	8.2
20980	M	5.27	11.9	38	5.75	33	33	0	65	0	2	0	126	15.8	61	15	52	135	Nor	N	N	tr	N	1.023	8.3
20987	F	5.07	12.1	38	7.25	17	17	0	79	2	2	0	131	18.9	69	16	39	170	Nor	N	N	N	N	1.016	8.4
20989	F	5.37	11.8	39	5.35	23	23	0	74	1	2	0	125	15.0	119	14	42	135	Nor	N	N	N	N	1.022	8.0
20991	F	4.80	11.0	35	5.20	35	35	0	62	3	0	0	129	17.9	57	39	64	160	Nor	N	N	tr	N	1.011	7.8

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N - Negative
Nor - Normal
* - 2+ Polychromic
1+ - Trace to slight
2+ - Slight to moderate
3+ - Moderate
4+ - Marked

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TABLE 5. Necropsy Observations.

Group, Rabbit No.	Sex	no gross lesions	localized consolidation and areas of petechiation, lung	scattered 1 mm gray foci, lung	abscess on peritoneum	multiple small cysts, kidneys	parovarian cyst, unilateral
Control:							
20960	M				x		
20968	M	x					
20988	M	x					
20961	F	x					
20963	F						x
20965	F		x				
50 mg/kg/day:							
20962	M	x					
20972	M	x					
20982	M	x					
20969	F	x					
20979	F					x	
20983	F	x					
500 mg/kg/day:							
20964	M	x					
20974	M	x					
20984	M	x					
20971	F			x			
20977	F	x					
20985	F	x					
5000 mg/kg/day:							
20976	M	x					
20978	M	x					
20980	M	x					
20987	F	x					
20989	F	x					
20991	F	x					

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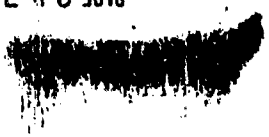
TABLE 6. Absolute (Grams) and Relative (% Body Weight) Organ Weights.

Group, Rabbit No.	Sex	Body Wt. gm	Spleen gm	Spleen %x10²	Liver gm	Liver %	Adrenals gm	Adrenals %x10²	Kidneys gm	Kidneys %	Testes/ Ovaries gm	Testes/ Ovaries %x10²	Heart gm	Heart %	Thyroid/ Parathyroid gm	Thyroid/ Parathyroid %x10²	Brain gm	Brain %
Control:																		
20960	M	2755	0.79	2.87	129.41	4.70	0.31	1.13	21.00	0.76	4.78	0.17	6.39	0.23	0.49	1.78	8.60	0.31
20968	M	3025	1.07	3.54	110.81	3.66	0.36	1.19	19.00	0.63	4.98	0.16	7.22	0.24	0.34	1.12	8.54	0.28
20988	M	3045	1.65	5.42	157.02	5.16	0.49	1.61	17.94	0.59	4.49	0.15	8.61	0.28	0.20	0.66	9.23	0.30
20961	F	2695	0.95	3.53	142.48	5.29	0.43	1.60	17.69	0.66	0.28	1.04	6.70	0.25	0.45	1.67	9.57	0.36
20963	F	3120	0.92	2.95	153.21	4.91	0.35	1.12	16.44	0.53	0.20	0.64	6.50	0.21	0.23	0.74	8.37	0.27
20965	F	2915	1.24	4.25	151.69	5.20	0.53	1.81	15.20	0.52	0.35	1.20	9.35	0.32	0.40	1.37	8.82	0.30
50 mg/kg/day:																		
20962	M	3355	1.52	4.53	169.86	5.06	0.51	1.52	21.28	0.63	5.62	0.17	7.60	0.23	0.31	0.92	9.85	0.29
20972	M	3180	2.70	8.49	176.02	5.54	0.43	1.35	22.55	0.71	6.02	0.19	7.64	0.24	0.38	1.19	9.35	0.29
20982	M	3275	1.58	4.82	147.00	4.49	0.60	1.83	18.60	0.57	6.15	0.19	7.30	0.22	0.35	1.07	9.60	0.29
20969	F	2830	2.35	8.30	162.00	5.72	0.52	1.84	24.87	0.88	0.40	1.41	7.05	0.25	0.50	1.77	8.42	0.30
20979	F	2755	1.23	4.46	142.30	5.17	0.73	2.65	20.26	0.74	0.30	1.09	8.37	0.30	0.29	1.05	9.09	0.33
20983	F	2985	0.83	2.78	114.49	3.84	0.30	1.01	17.00	0.57	0.25	0.84	6.60	0.22	0.38	1.27	9.00	0.30
500 mg/kg/day:																		
20964	M	3235	2.01	6.21	142.48	4.40	0.41	1.27	21.20	0.66	8.70	0.27	7.60	0.23	0.43	1.33	9.55	0.30
20974	M	2855	0.72	2.52	134.91	4.73	0.28	0.98	15.99	0.56	5.39	0.19	6.44	0.23	0.27	0.95	9.07	0.32
20984	M	3230	1.59	4.92	160.41	4.97	0.41	1.27	22.51	0.70	9.15	0.28	7.70	0.24	0.34	1.05	9.68	0.30
20971	F	2950	0.85	2.88	151.07	5.12	0.72	2.44	17.42	0.59	0.30	1.02	6.10	0.21	0.40	1.36	8.52	0.29
20977	F	2705	1.18	4.36	117.55	4.35	0.42	1.55	15.35	0.57	0.25	0.92	6.52	0.24	0.35	1.29	8.60	0.32
20985	F	3110	1.67	5.37	136.42	4.39	0.53	1.70	20.55	0.66	0.30	0.96	6.57	0.21	0.40	1.29	9.65	0.31
5000 mg/kg/day:																		
20976	M	2275	0.65	2.86	85.35	3.75	1.13	4.97	15.75	0.69	3.15	0.14	5.60	0.25	0.45	1.98	9.89	0.43
20978	M	3545	1.97	5.56	156.22	4.41	0.31	0.87	20.15	0.57	8.50	0.24	7.80	0.22	0.28	0.79	10.00	0.28
20980	M	3280	1.05	3.20	153.12	4.67	0.68	2.07	18.50	0.56	5.03	0.15	7.75	0.24	0.20	0.61	9.22	0.28
20987	F	2980	1.09	3.66	127.09	4.26	1.09	3.66	18.48	0.62	0.25	0.84	5.95	0.20	0.20	0.67	9.30	0.31
20989	F	2720	1.52	5.59	139.12	5.11	0.40	1.47	16.88	0.62	0.25	0.92	6.25	0.23	0.32	1.18	9.28	0.34
20991	F	2550	1.32	5.18	166.88	6.54	0.78	3.06	15.82	0.62	0.25	0.98	5.72	0.22	0.32	1.25	9.89	0.39

134-015

alarm reaction?



Firemaster 680: Twenty-eight Day Toxicity Study in Rabbits.

TABLE 7. Histomorphologic Observations.

Group, Rabbit No.	Sex	Brain: encephalitozoonosis	Lungs: focal accumulations of brown pigment laden macrophages	Heart: recent myocardial hemorrhage	Heart: myocarditis	Lymph Node: abscess	Small Intestine: coccidiosis	Large Intestine: nematodes	Liver: portal lymphocytic infiltrate	Kidneys: interstitial lymphocytic infiltrate, tubule regeneration, cortex	Kidneys: cysts, corticomedullary junction	Skin: acanthosis	Peripheral nerve	Eye	Pituitary	Thyroid	Adrenal	Spleen	Thymus	Bone marrow	Stomach	Pancreas	Gallbladder	Urinary bladder	Testes/ovaries	Skeletal muscle
Control:																										
20960	M	n	n	n		n	n	x	n			n		n												
20968	M	n	n	n		n	n	n	n			n		n												
20988	M	n	n	n		n	n	n	n			n		n												
20961	F	n	n	4		n	n	n	n			2		n	n											
20963	F	x	n	n		n	n	n	n			n		n	n											
20965	F	n	4	n	3	n	n	n	n			n		n	n											
50 mg/kg/day:																										
20962	M								n	n		n														
20972	M								n		3	n														
20992	M								n	n		n														
20969	F								n		3	n														
20979	F									3		2														
20983	F								n	n		n														
500 mg/kg/day:																										
20964	M									3		3														
20974	M								n	n		n														
20984	M								n	n		n														
20971	F								n	n		n														
20977	F								n	n		n														
20985	F								n	n		n														
5000 mg/kg/day:																										
20976	M	n	n	n		n	n	n	n	n		n		n	n											
20978	M	n	n	n		n	n	n	n	n		n		n	n											
20980	M	n	n	n		n	n	n	n	n		n		n	n											
20987	F	x	n	n	3	n	n	n	3	4		n		n	n											
20989	F	n	n	n		n	x	n	n	n		n		n	n											
20991	F	n	n	n		n	n	n	n	n		n		n	n											

134-015

Code: n - normal or essentially so; x - condition present; 2 - very slight; 3 - slight; 4 - moderate; 5 - marked; 6 - extreme

International Research
and Development Corporation
MATTAWAN, MICHIGAN, U.S.A. 49071 TELEPHONE (616) 668-3336

December 13, 1977

Mr. Richard C. Nametz
Velsicol Chemical Corporation
Technical Center
1975 Green Road
Ann Arbor, Michigan 48105

Ref: 134-015

Dear Dick:

This letter is in response to your recent request concerning the fate of the bromine analysis of certain selected samples by neutron activation for the above referenced study (28-Day Dermal Toxicity Study in Rabbits with Firemaster 680). The appropriate tissue and blood samples were sent via REA Air Express on December 9, 1974 to The Union Carbide Corporation, Tuxedo, New York, to the attention of Carl Najork. This shipment was following receipt by Union Carbide, subsequently "lost" by them. Despite several attempts by IRDC personnel to have Union Carbide locate the samples, they were never recovered.

As you recall, following the loss of these samples IRDC discontinued using the services of Union Carbide and we understand that they have since then discontinued the neutron activation analysis aspect of their business.

I trust that the above clarifies what occurred with regard to the tissue and blood samples. Should you have further questions or if I can be of additional assistance, please do not hesitate to contact me.

Warmest personal regards for a most enjoyable holiday season.

Sincerely,

Wilson P. Dean, B.A.
Assistant to the President

WPD:ps

0 2 9 8

88-7800184

8EH0678-0184 (2)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster® 680, (Micronized)

SUBJECT: Twenty-one Day Inhalation Toxicity Study in Rats.

PAGE 0480

What is a "slight" incidence? Why not give numbers.

No immediate and dramatic signs but the compound is absorbed from the lungs (which act as a depot) and is stored in liver and fat. ~~Kidney (?)~~ The Kidney ~~content~~ and blood content cannot be evaluated in the absence of urinary levels. The high Br content of Kidney and blood may be related to an active excretion process.

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborators:

R. G. Geil, D.V.M., Director of Pathology
W. P. Dean

No Br data were submitted - just a summary.

Joseph Seifter
Aug 9, 1978.

[redacted]

Date: February 11, 1975

[redacted]

134-016

Document declassified 8-22-78

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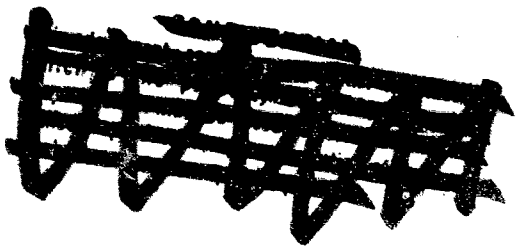

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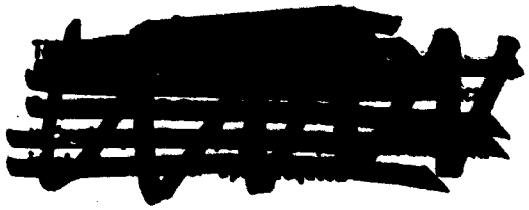


I. SYNOPSIS

In a 21-day inhalation study, albino rats were subjected to Firemaster®680 (micronized) at atmospheric concentrations of 5 and 20 mg/L. Exposure of the rats in each group to their respective atmospheric concentrations was conducted for 4 hours daily, 5 days each week, for 3 weeks. A control group of rats was employed wherein only air, not containing the test compound, was introduced into the test chamber.

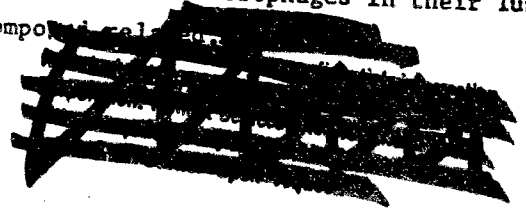
Observations were made daily for general physical appearance, behavior and pharmacotoxic signs. Individual body weights and food consumption values were obtained weekly. Hematological, biochemical and urinalysis studies were conducted at 20 days. Bromine analysis by neutron activation of liver, fat, kidney, lung and blood samples was conducted on samples taken at terminal necropsy.

Clinical observations obtained during the study period did not reveal any significant compound related findings. No deaths occurred in either the control or treated groups during the 21-day period of study.

No compound related changes in body weight or food consumption values occurred during the study period.

Hematological, biochemical and urinalysis studies obtained at 20 days did not exhibit changes which were considered related to compound application. The results of Bromine analysis of selected tissues and blood by neutron activation will be presented when completed as Appendix I.

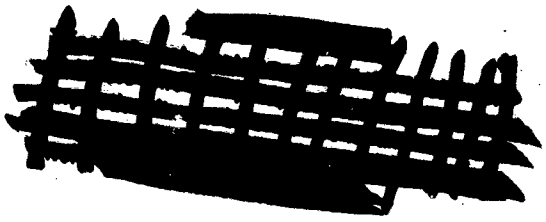
No compound related gross pathologic lesions or variations in organ weight were seen at necropsy in any rats from the experimental groups. Microscopically, most rats from the 2 experimental groups had scattered foci of foamy alveolar macrophages in their lungs; these foci were considered compo[illegible]



II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on September 19, 1974.

It was identified as "Firemaster® 680, micronized material, from lot 761-11", and was received as a fine white powder.



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III. CLINICAL STUDIES

A. METHOD:

1. General Procedure:

Fifteen male and 15 female rats of the Spartan strain, weighing from 205 to 254 grams, were used in this study. The rats were acclimated for a period of 10 days following which the rats were divided into 3 groups of 5 male and 5 female rats each. The rats were individually housed in metal cages suspended above the droppings and were maintained in temperature and humidity controlled quarters during the study period. Purina Laboratory Chow for rats and water were available ad libitum.

Following the 21 days of study, all rats were sacrificed and necropsied. Selected tissues were collected and were processed for histopathology.

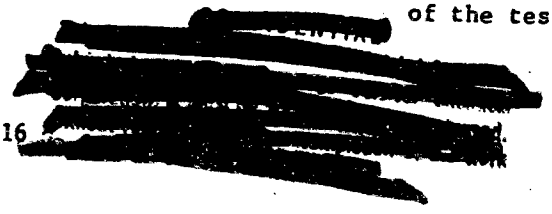
2. Compound Administration:

Each group of 5 male and 5 female rats was placed in a sealed 59.1 liter glass chamber and was exposed for 4 hours, 5 days weekly for 3 weeks, to a dynamic atmosphere containing the test material as a dust. In order to prevent "piling up" during the exposure, the rats were separated by sex into 4 units of 2 or 3 rats each.

Addition of the test compound to the test chamber atmosphere was controlled by a Wright Dust Feeder. Dried and filtered air was passed through the mechanism and directly into the exposure chamber. Air flow was regulated by means of a flowmeter.

The atmospheric concentrations employed were as follows:

Group I - Control: Air flow only, without the introduction of the test compound.



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Group II - Firemaster® 680: 5 mg/Liter.
Group III - Firemaster® 680: 20 mg/Liter.

3. Observations:

Prior to and immediately following each daily exposure, each rat was observed for general physical appearance, behavior and pharmacotoxic signs. During each four hour daily exposure, each group of 10 rats was continually observed for the above signs.

Individual body weights and food consumption were obtained weekly.

4. Clinical Laboratory Tests:

At day 20 of the study period, 24 hour fasting blood samples were obtained from all rats for the following analysis:

a. Hematology:

Hematological studies included hemoglobin concentration[1], hematocrit[2], total erythrocyte count[3], and total[3] and differential leucocyte counts.

b. Biochemistry:

Biochemical studies included plasma urea nitrogen[4], fasting plasma glucose[4], serum alkaline phosphatase activity[4], and serum glutamic oxalacetic and pyruvic transaminase activities[4].

c. Urinalysis:

Urinalysis studies included measurement of volume, specific gravity and pH[5], determination of color and appearance; qualitative tests for albumin[5], glucose[5], bilirubin[5] and occult blood[5] and microscopic examination of the sediment.

5. Bromine Analysis:

Samples of liver, fat, kidney, lung and blood were collected from all animals at the terminal necropsy. All samples collected from the rats in the control and high dosage level groups were analyzed for bromine content by neutron activation analysis.

how determined?

B. RESULTS:

1. General Behavior, Appearance and Survival:

Clinical observations noted in the control and treated groups during the 21 day study period included clear nasal discharge, soft stool and respiratory congestion. Nasal porphryin discharge, also observed in the control group, was noted in a greater number of rats in treated groups. A slight incidence of ocular porphyrin discharge was observed in the treated groups, this sign was not present in the control groups. One rat in group II (5 mg/L of Firemaster® 680) showed a yellow discharge from the anus for 1 day only.

how established statistically?

Based upon those signs noted above, no significant compound related signs were observed during the study period.

No deaths occurred in either the control or treated groups during the 21-day period of study.

2. Body Weight (Table 1):

Changes in body weight during the 21 day study period were similar for the control group and the 2 treated groups of rats which received Firemaster® 680.

3. Food Consumption (Table 2):

Food consumption values obtained from rats in the control and treated groups were essentially similar throughout the study period.

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4. Clinical Laboratory Tests (Tables 3-5):

a. Hematology:

No changes which were considered related to compound application were observed in hematological studies conducted at 20 days.

b. Biochemistry:

Biochemical parameters evaluated during the study period did not reveal any changes which were considered related to compound application.

c. Urinalysis:

Urinalysis values obtained at 20 days did not reveal any changes which were considered related to compound administration.

5. Bromine Analysis:

The results of the bromine analysis determined by neutron activation, conducted on samples of liver, fat, kidney, lung and blood from animals in the control and high dosage level groups, will be presented as Appendix I immediately upon completion of the analyses.

[redacted]

0 2 4 7

IV. PATHOLOGICAL STUDIES

A. METHODS:

1. Gross Pathology:

At the completion of the exposure period, all rats were sacrificed by decapitation and necropsied. Selected organs were weighed and representative tissues from each rat were collected in buffered neutral 10% formalin. Samples of liver, fat, kidney, lung and blood from each rat were frozen for subsequent bromine analysis.

2. Histopathology:

The following tissues from each rat from the control and 20 mg/Liter groups were paraffin embedded, sectioned, stained with hematoxylin and eosin and examined microscopically:

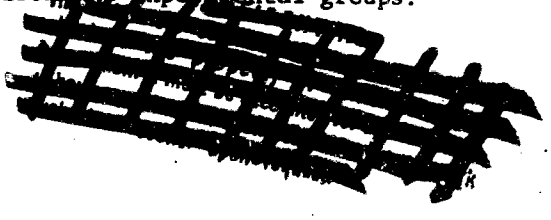
nasal turbinate area	kidneys
trachea	urinary bladder
lung	ovaries/testes
spleen	bone/marrow
pancreas	heart
stomach	mediastinal lymph node
duodenum	thyroid/parathyroid
colon	eye
mesenteric lymph node	brain
liver	pituitary
adrenals	

Hematoxylin and eosin stained paraffin sections of lung from the rats at the 5 mg/Liter exposure level also were prepared and examined.

B. RESULTS:

1. Gross Pathology (Table 6) and Organ Weights (Tables 7-8):

No gross pathologic lesions or organ weight variations related to exposure to the test material at either level were seen at necropsy in any rats from the experimental groups.



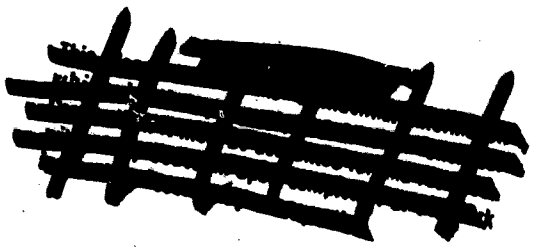
2. Histopathology (Table 6):

Compound related histopathologic lesions were limited to the lungs of rats from both experimental groups. A majority of animals from both groups had small focal accumulations of foamy alveolar macrophages scattered throughout the lungs. These cells are occasionally seen in the lungs of untreated rats and did occur in several rats from the control group in this study, but in the control animals, the foam cells were associated with mononuclear inflammatory cells in perivascular infiltrates and, except in Rat 21517 of the control group, were not the predominant cell type in the inflammatory foci. In most affected rats from the experimental groups, however, the foamy alveolar macrophage was the predominant cell type and frequently the only cell type in the cellular foci scattered throughout the lung.

why not a liver

numbers! numbers! What does "most" mean?

Toxicology data of this nature can be accepted only if they are Quantitative and objective.



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2. Microhematocrit, John B. Miale, 3rd Ed., 1967, The C. V. Mosby Company, p. 1154.
3. Coulter Particle Size Counter, Model A, Coulter Electronics, 590 W. 20th Street, Hialeah, Florida.
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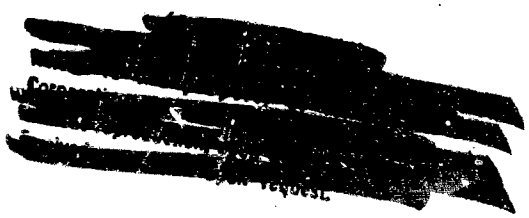

Firemaster® 680: Twenty-one D[illegible] Inhalation Toxicity Study in Rats.

TABLE 1. Individual Weekly Body Weights, Grams.

Group, Rat No.	Sex	Control 1	Compound Administration Weeks 1	2	3	4
Control:						
21512	M	216	262	278	292	309
21514	M	240	289	296	310	325
21516	M	227	280	290	312	335
21518	M	226	265	276	275	284
21520	M	225	279	300	315	332
Mean		227	275	290	301	317
21511	F	236	253	258	260	266
21513	F	246	264	262	265	276
21515	F	235	248	240	249	259
21517	F	241	253	252	250	249
21519	F	236	237	229	234	252
Mean		239	251	248	252	260
5 mg/Liter:						
21522	M	217	269	288	300	320
21524	M	228	279	308	318	345
21526	M	232	273	292	308	324
21528	M	205	250	262	285	302
21530	M	221	275	294	310	318
Mean		221	269	289	304	322
21521	F	244	270	274	272	274
21523	F	234	248	244	247	255
21525	F	247	255	252	244	260
21527	F	254	274	272	274	276
~~21529~~	F	242	262	264	260	266
Mean		244	262	261	259	266
20 mg/Liter:						
21532	M	236	293	320	321	365
21534	M	215	272	288	308	324
21536	M	250	295	322	322	363
21538	M	217	269	284	295	302
21540	M	235	288	302	325	358
Mean		231	283	303	314	342
21531	F	247	265	256	270	268
21533	F	241	253	244	245	256
21535	F	250	257	248	248	250
21537	F	249	254	250	265	261
21539	F	245	259	258	266	262
Mean				251	259	259

[redacted]

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Firemaster®680: Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 2. Individual Weekly Food Consumption, Grams.

Group, Rat No.	Sex	Compound Administration Weeks 1	2	3	4
Control:					
21512	M	153	167	163	131
21514	M	173	180	175	139
21516	M	162	184	182	147
21518	M	157	178	159	137
21520	M	151	182	176	135
Mean		159	178	171	138
21511	F	131	152	143	116
21513	F	135	145	140	113
21515	F	127	134	142	128
21517	F	128	143	133	113
21519	F	117	126	125	118
Mean		128	140	137	118
5 mg/Liter:					
21522	M	176	181	173	131
21524	M	169	200	193	137
21526	M	155	186	219	135
21528	M	165	165	178	133
21530	M	167	178	180	132
Mean		166	182	189	134
21521	F	137	141	135	104
21523	F	134	132	133	116
21525	F	124	130	122	106
21527	F	141	141	139	115
21529	F	146	139	142	108
Mean		134	137	134	110
20 mg/Liter:					
21532	M	166	184	192	152
21534	M	173	183	169	132
21536	M	163	179	197	150
21538	M	174	171	180	135
21540	M	156	176	187	145
Mean		166	179	185	143
21531	F	132	138	131	109
21533	F	124	122	119	109
21535	F	124	125	123	104
21537	F	139	126	137	112
21539	F	[illegible]	135	128	111
Mean		132		128	109

[illegible] confi[illegible] property of Vel[illegible]

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Firemaster® 680, (Micronized): Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 3. Individual Hematological Values.

Group, Rat No.	Sex	Erythrocyte 10^6/cmm	Hematocrit %	Hemoglobin gm/100 ml	Leucocytes 10^3/cmm	Neutrophils Seg. %	Neutrophils Non-Seg. %	Lymphocytes %	Eosinophils %	Monocytes %	Basophils %
Control:											
21512	M	7.62	48	16.1	9.18	9	0	88	3	0	0
21514	M	7.71	50	14.8	7.56	12	0	88	0	0	0
21516	M	7.60	50	16.0	12.01	9	0	91	0	0	0
21518	M	7.83	51	17.1	15.13	8	0	92	0	0	0
21520	M	6.83	47	15.3	12.87	9	0	89	2	0	0
Mean		7.52	49	15.9	11.35	9	0	90	1	0	0
21511	F	7.31	47	14.9	11.47	9	0	91	0	0	0
21513	F	7.36	49	15.3	10.07	20	0	80	0	0	0
21515	F	7.28	49	15.1	9.81	8	0	91	1	0	0
21517	F	6.06	38	11.7	10.19	26	0	73	1	0	0
21519	F	7.59	48	14.4	10.93	10	0	86	4	0	0
Mean		7.12	46	14.3	10.49	15	0	84	1	0	0
5 mg/Liter:											
21522	M	8.17	53	17.1	11.60	12	0	86	2	0	0
21524	M	7.59	44	17.1	15.72	16	0	83	1	0	0
21526	M	8.24	53	16.7	14.68	12	0	86	2	0	0
21528	M	8.05	55	16.6	11.84	10	0	90	0	0	0
21530	M	8.37	56	17.8	12.25	10	0	89	1	0	0
Mean		8.08	52	17.1	13.22	12	0	87	1	0	0
21521	F	7.55	47	14.9	9.18	12	0	88	0	0	0
21523	F	7.95	50	16.3	9.14	21	0	79	0	0	0
21525	F	7.75	50	16.1	9.05	22	0	77	1	0	0
21527	F	7.95	54	16.5	13.77	12	0	86	2	0	0
21529	F	8.20	52	17.0	7.73	10	0	88	2	0	0
Mean		7.88	51	16.2	9.77	15	0	84	1	0	0
20 mg/Liter:											
21532	M	7.72	52	16.6	14.26	12	0	86	2	0	0
21534	M	7.82	50	15.9	8.03	14	0	86	0	0	0
21536	M	7.31	51	16.2	16.01	16	0	83	1	0	0
21538	M	7.96	51	16.6	15.83	14	0	83	3	0	0
21540	M	7.48	47	15.6	14.88	26	0	73	1	0	0
Mean		7.66	50	16.2	13.80	16	0	33	1	0	0
21531	F	7.84	51	16.1	10.17	18	0	80	2	0	0
21533	F	7.95	53	17.0	7.05	10	0	90	0	0	0
21535	F	7.81	50	15.8	10.65	14	0	85	1	0	0
21537	F	7.72	48	15.4	7.70	11	0	87	2	0	0
21539	F	6.73	41	13.3	6.89	11	0	89	0	0	0
Mean		7.61	49	15.5	8.49	13	0	86	1	0	0

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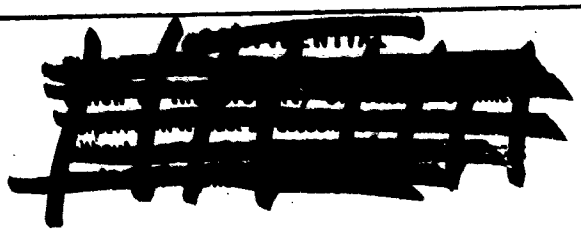

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TABLE 4. Individual Biochemical Values.

Group, Rat No.	Sex	Glucose mg/100 ml	B.U.N. mg/100 ml	Alkaline Phosphatase int 1 U/ml	S.G.O.T. int'l Units/ml	S.G.P.T. int'l Units/ml
Control:						
21512	M	100	16.2	203	148	19
21514	M	106	22.2	188	189	37
21516	M	110	20.0	175	202	24
21518	M	101	19.9	199	277	76
21520	M	105	18.1	174	160	17
Mean		104	19.3	188	195	35
21511	F	108	26.9	112	173	14
21513	F	115	19.0	132	186	18
21515	F	135	24.0	161	184	11
21517	F	120	22.2	83	160	15
21519	F	140	32.6	120	200	11
Mean		124	24.9	122	181	14
5 mg/Liter:						
21522	M	96	19.9	185	172	18
21524	M	100	25.5	184	123	22
21526	M	108	19.1	191	162	33
21528	M	108	21.0	221	167	24
21530	M	96	18.0	192	164	28
Mean		102	20.7	194	158	25
21521	F	107	22.2	67	125	27
21523	F	121	20.2	117	153	27
21525	F	113	20.0	122	135	18
21527	F	119	22.5	85	143	18
21529	F	134	18.5	115	124	17
Mean		119	20.7	101	136	21
20 mg/Liter:						
21532	M	107	17.0	217	130	26
21534	M	95	19.9	213	176	25
21536	M	112	22.5	254	158	36
21538	M	93	17.0	160	175	33
21540	M	96	18.1	198	164	31
Mean		101	18.9	208	161	30
21531	F	105	28.3	140	147	22
21533	F	111	28.1	125	145	24
21535	F	106	20.2	90	135	26
21537	F	123	23.9	100	135	21
21539	F	117	20.9	148	149	24
Mean		112	24.1	121	142	23

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Firemaster® 680, (Micronized): Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 5. Individual Urinalysis Values.

Rat No.	Sex	Volume ml	Color and Appear.	pH	Spec. Grav.	Albumin	Bilirubin	Glucose	Occult Blood	Leucocytes	Erythrocytes	Epi. Cells	Amor. Urates	Triple Phos.	Calc. Ox.	Bacteria
Control:																
21512	M	3.0	S-cl	6.2	1.078	N	N	N	N		occ		F	F		F
21514	M	2.0	LS-cl	6.4	>1.080	N	N	N	N		1-3	occ	F	F		M
21516	M	2.0	LAm-cl	6.4	>1.080	2+	N	N	N		1-3		F	F	occ	M
21518	M	1.5	LAm-cl	6.3	>1.080	1+	N	N	N				F	F	F	F
21520	M	1.5	LAm-cl	6.4	>1.080	tr	N	N	N		occ	occ	F	F		M
21511	F	1.0	S-C	6.2	>1.080	N	N	N	N		1-3	occ	F	F		F
21513	F	1.0	S-C	6.2	>1.080	N	N	N	N		occ	occ	F	F		F
21515	F	1.0	DS-cl	7.7	1.076	N	N	N	3+	5-8	1-3	occ	F	F	occ	M
21517	F	2.0	S-cl	6.0	>1.080	N	N	N	4+				F	F		F
21519	F	1.0	S-cl	6.1	>1.080	2+	N	N	N		occ		F	F		F
5 mg/Liter:																
21522	M	0.5	DS-cl	7.4	>1.080	1+	N	N	N		occ	occ	M	F		F
21524	M	7.5	S-cl	6.6	1.038	N	N	N	tr			occ	F	M		M
21526	M	2.0	LAm-cl	6.6	>1.080	N	N	N	N		occ		F	F		F
21528	M	1.5	LAm-cl	6.8	1.075	tr	N	N	tr		occ	occ	F	F		M
21530	M	2.0	LAm-cl	6.2	>1.080	1+	N	N	N			occ	F	F		F
21521	F	5.0	S-cl	6.2	1.044	1+	N	N	N		1-3		F	F		F
21523	F	1.0	S-cl	6.0	>1.080	1+	N	N	N		1-3	occ	F	F		F
21525	F	0.5	DS-cl	7.8	>1.080	tr	N	N	tr		1-3	occ	M	F	occ	F
21527	F	2.0	S-cl	6.1	>1.080	N	N	N	N				F	F		F
21529	F	2.5	S-cl	6.8	1.063	N	N	N	N		1-3		F	F	F	M
20 mg/Liter:																
21532	M	4.0	S-cl	6.8	1.067	2+	N	N	N			occ	F	F	occ	M
21534	M	0.5	LAm-cl	6.2	1.077	1+	N	N	N			occ	M	F	occ	M
21536	M	2.0	S-cl	6.6	1.079	2+	N	N	tr		occ	occ	F	F		M
21538	M	5.0	S-cl	6.5	1.050	2+	N	N	1+		1-3	occ	M	F	occ	M
21540	M	2.0	DS-cl	7.8	1.079	2+	N	N	tr		1-3	1-3	F	F	occ	M
21531	F	0.5	DS-cl	7.9	1.077	3+	N	N	2+		1-3	1-3	F	F		F
21533	F	1.0	DS-cl	8.1	1.072	1+	N	N	4+			occ	F	F	occ	M
21535	F	2.0	S-cl	6.2	1.069	tr	N	N	N				F	F		F
21537	F	0.5	S-cl	6.0	>1.080	N	N	N	N				F	F		F
21539	F	0.5	S-cl	6.7	1.079	tr	N	N	3+			occ	F	F		F

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Stremaster®680, (Micronized): PAGE 0497 Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 6. Pathologic Observations.

Group, Rat No.	Sex	GROSS: no gross lesions	GROSS: few scattered dark red foci, lung	GROSS: few scattered gray foci, lung	GROSS: hydronephrosis, unilateral	GROSS: hydrometra	MICROSCOPIC Lung: scattered foci of alveolar foam cells	Lung: perivascular inflammatory infiltrate, primarily lymphocytic	Lung: focal consolidation	Lung: focal ossification	Nasal Turbinates: neutrophil inflammatory exudate	Lymph Nodes: erythrophagocytosis	Lymph Nodes: reticuloendothelial hyperplasia	Large Intestine: nematode	Liver: scattered inflammatory foci	Kidneys: interstitial lymphocytic infiltrate, tubule regeneration	Brain	Eye	Pituitary	Thyroid	Adrenals	Trachea	Heart	Spleen	Bone Marrow	Stomach	Small intestine	Pancreas	Urinary bladder	Testes/Ovaries
Control:																														
21512	M	x					n				n	n		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21514	M			x					3		n	n		n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21516	M	x					n				n	n		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21518	M	x							4		n	n		n	n	n	n	n		n	n	n	n	n	n	n	n	n	n	n
21520	M	x					n				n	n		n	n	n	n					n	n	n	n	n	n	n	n	n
21511	F					x			3		n	n		x	n	n	n	n		n	n	n	n	n	n	n	n	n	n	n
21513	F					x			3		n	n		n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21515	F			x					3		n	n		x	n	n	n	n		n	n	n	n	n	n	n	n	n		
21517	F		x					2	4		n	5		x	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21519	F	x							3		4	n		x	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
5 mg/Liter:																														
21522	M	x						3																						
21524	M				x			4																						
21526	M	x						2																						
21528	M	x						4																						
21530	M	x						3																						
21521	F	x							3																					
21523	F	x						3	3																					
21525	F							3	3																					
21527	F	x						4																						
21529	F	x						3	3																					
20 mg/Liter:																														
21532	M	x						3			n	n		n	n	n	n	n			n	n	n	n	n	n	n	n	n	n
21534	M	x						3			n	n		n	n	n	n			n	n	n	n	n	n	n	n	n	n	n
21536	M							2	4		n	n		n	n	3	n	n		n	n	n	n	n	n	n	n	n	n	n
21538	M	x						3		3	n	n		x	n	n	n			n	n	n	n	n	n	n	n	n	n	n
21540	M							4		3	n		4	n	n	n	n	n		n	n	n	n	n	n	n	n	n	n	n
21531	F	x						3	3		n	n		n	n	n	n	n		n	n	n	n	n	n	n	n	n	n	n
21533	F	x						4			n	n		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21535	F	x						4	3		n	n		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21537	F	x						3	3		n	4		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21539	F					x		4	4		n	3		x	n	n	n		n	n	n	n	n	n	n	n	n	n	n	n

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Code: n - normal or essentially so; x - condition present; 2 - very slight; 3 - slight; 4 - moderate; 5 - marked; 6 - extreme

Firemaster®680, (Micronized): Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 7. Absolute (Grams) and Relative (% Body Weight) Organ Weights.

Group	Sex	Body Wt. Gm.	Spleen gm	Spleen %	Liver gm	Liver %	Adrenals gm	Adrenals %x10²	Kidneys gm	Kidneys %	Heart gm	Heart %	Lung gm	Lung %	Thyroid/ Parathyroid gm	Thyroid/ Parathyroid %x10²	Brain gm	Brain %
Control:																		
	M	317	0.89	0.28	12.51	3.95	0.057	1.81	2.75	0.87	1.10	0.35	1.44	0.45	0.024	0.76	1.62	0.51
	F	260	0.70	0.27	10.05	3.86	0.070	2.68	1.94	0.74	0.98	0.38	1.32	0.58	0.019	0.74	1.66	0.64
5 mg/Liter:																		
	M	322	0.89	0.28	13.34	4.14	0.059	1.82	2.66	0.83	1.20	0.37	1.60	0.50	0.032	0.99	1.66	0.52
	F	266	0.70	0.26	9.86	3.70	0.087	3.28	2.06	0.77	0.98	0.37	1.70	0.64	0.035	1.31	1.71	0.64
20 mg/Liter:																		
	M	342	0.80	0.23	13.53	3.95	0.058	1.68	2.80	0.82	1.23	0.36	1.75	0.51	0.023	0.68	1.68	0.49
	F	259	0.77	0.30	10.49	4.04	0.084	3.24	2.10	0.81	1.09	0.42	1.56	0.60	0.024	0.93	1.57	0.61

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Firemaster®, (Micronized): Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE 8. Organ Weights, Grams.

Group, Rat No.	Sex	Body Wt. Grams	Spleen	Liver	Adrenals	Kidneys	Heart	Lung	Thyroid/ Parathyroid	Brain
Control:										
21512	M	309	0.70	12.03	0.067	2.55	0.98	1.35	0.028	1.60
21514	M	325	0.90	12.28	0.043	2.85	1.05		0.034	1.70
21516	M	335	0.98	12.75	0.078	2.85	1.11	1.28	0.019	1.51
21518	M	284	1.00	11.35	0.041	2.52	1.28	1.57	0.013	1.68
21520	M	332	0.85	14.12	0.058	2.98	1.10	1.55	0.027	1.62
21511	F	266	0.80	10.48	0.058	2.02	1.00	1.45	0.012	1.70
21513	F	276	0.72	10.00	0.082	2.00	0.95	2.05	0.027	1.65
21515	F	259	0.72	9.50	0.063	1.83	0.95	1.55	0.011	1.68
21517	F	249	0.65	10.02	0.074	1.93	1.00	1.35	0.019	1.60
21519	F	252	0.63	10.25	0.072	1.90	1.02	1.20	0.027	1.65
[illegible] mg/Liter:										
21522	M	320	0.89	13.20	0.065	2.54	1.23	1.68	0.033	1.68
21524	M	345	0.93	15.25	0.047	2.93	1.20	1.45	0.026	1.55
21526	M	324	0.85	13.52	0.058	2.72	1.15	1.60		1.80
21528	M	302	0.78	12.70	0.058	2.50	1.28	1.45	0.026	1.62
21530	M	318	1.00	12.02	0.065	2.62	1.15	1.80	0.043	1.65
21521	F	274	0.65	10.43	0.087	2.10	1.05	1.93	0.042	1.70
21523	F	255	0.80	9.93	0.079	1.93	1.00	1.85	0.030	1.75
21525	F	260	0.50	8.50	0.092	2.20	0.90	1.45	0.029	1.58
21527	F	276	0.70	9.53	0.077	1.85	1.00	1.78	0.040	1.75
21529	F	266	0.85	10.90	0.101	2.20	0.93	1.50	0.033	1.79
[illegible] mg/Liter:										
21532	M	365	0.83	15.40	0.059	2.70	1.25	1.53	0.018	1.70
21534	M	324	0.65	11.50	0.057	2.58	1.15	1.35	0.033	1.59
21536	M	363	1.05	14.56	0.053	3.00	1.28	1.70	0.023	1.80
21538	M	302	0.70	11.70	0.061	2.60	1.23	2.35	0.022	1.70
21540	M	358	0.78	14.50	0.058	3.12	1.22	1.83	0.021	1.63
21531	F	268	0.88	11.05	0.077	1.90	0.98	1.75	0.035	1.45
21533	F	256	0.60	8.65	0.084	2.00	1.04	1.55	0.021	1.72
21535	F	250	0.93	12.43	0.073	2.13	1.33	1.77	0.021	1.62
21537	F	261	0.65	11.55	0.095	2.45	1.02	1.25	0.018	1.55
21539	F	262	0.78	8.75	0.091	2.00	1.10	1.50	0.026	1.53

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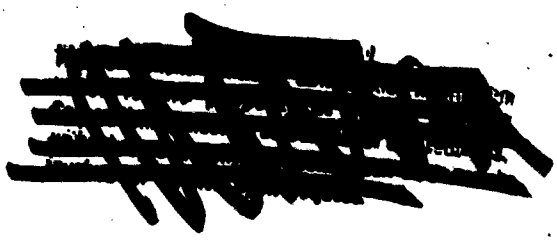
APPENDIX I

Twenty-one Day Inhalation Toxicity Study in Rats with Firemaster® 680 (Micronized)

Bromine Analysis

Bromine analysis was conducted for liver, fat, kidney, lung and blood samples collected at terminal necropsy for all rats used in this study. The samples were analyzed by Neutron Activation for bromine content. The values obtained are shown in the attached teble.

Based upon the data obtained, very marked increases in bromine content were found in the lungs of treated rats. Increases in bromine content also were found in liver, fat, kidney and blood samples obtained at terminal sacrifice.



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Firemaster® 680: Twenty-one Day Inhalation Toxicity Study in Rats.

TABLE Bromine Content, ppm.

Group, Rat No.	Sex	Terminal Values				
		Liver	Fat	Kidney	Lung	Blood
Control:						
21512	M	2.2	-	5.8	7.8	8.1
21514	M	2.3	3.6	8.4	8.2	4.8
21516	M	2.9	2.9	5.5	7.6	11.6
21518	M	4.1	3.4	7.1	4.6	11.4
21520	M	4.4	3.4	7.3	6.2	13.2
Mean		3.18	3.33	6.82	6.88	9.82
21511	F	2.1	4.1	7.5	7.6	6.4
21513	F	-	3.1	5.6	8.4	6.7
21515	F	2.0	3.6	6.9	4.8	8.2
21517	F	1.5	2.3	3.3	6.2	14.2
21519	F	3.6	4.2	6.9	7.3	11.3
Mean		2.3	3.46	6.04	6.86	9.36
20 mg/Liter:						
21532	M	3.8	10.4	17.5	11,800	16.0
21534	M	7.8	12.6	12.0	13,200	21.8
21536	M	5.7	6.9	16.4	11,600	16.5
21538	M	5.1	10.6	14.6	9,200	13.8
21540	M	16.1	7.8	13.6	11,300	14.7
Mean		7.7	9.66	14.82	11,420	16.56
21531	F	4.6	15.6	13.2	9,900	17.7
21533	F	8.2	8.5	8.7	13,600	19.2
21535	F	21.4	5.8	13.2	17,000	21.9
21537	F	8.2	9.1	11.1	12,200	16.7
21539	F	6.1	12.4	19.2	12,000	11.0
Mean		9.7	10.3	13.08	12,940	17.30

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88-7800184

8EHQ-0678-0184 (P)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: ABS Resin/Sb_2O_3 ?

SUBJECT: Acute Inhalation Toxicity in the Albino Rat After Pyrolysis.

1. What was tested? What Concentration?
2. Appears to be an irritant of ocular + upper respiratory tract mucosa.
3. May be a pulmonary irritant.

Inadequate study

Joseph Gaylor
Aug 8, 1978

Francis X. Mazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Document declassified
8-22-78

Collaborators:

Dr. R. G. Geil, D.V.M.,
Vice President - Director
of Pathology

W. P. Dean

Date: March 12, 1975

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I. SYNOPSIS

ABS Resin/Sb_2O_3 was evaluated for acute inhalation toxicity in albino rats after pyrolysis. No deaths occurred during the 4 hour exposure period or during the subsequent 14 day period of observation.

The pharmacodynamic and/or toxic signs observed are recorded in the body of this report.

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 2 of 10 rats showing petechiation of the lungs.

0 2 6 3

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II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on November 29, 1974. It was identified as "ABS Resin/Sb_2O_3, Lot No. 607-43-D" and was received as off-white, small cylindrical chunks.

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III. METHOD:

A. General Procedure:

Five male and 5 female albino rats of the Spartan strain, weighing from 238 to 278 grams, were exposed to an atmosphere containing pyrolysis products of the test material.

The rats were housed by sex in groups of 5 rats each in wire mesh cages elevated above the droppings and maintained in temperature and humidity controlled quarters throughout the pre-exposure and post-exposure periods. Food and water were available ad libitum.

During the 4 hour exposure the rats were observed for changes in behavior and/or appearance. Immediately following the exposure, they were examined closely for pharmacodynamic and/or toxic signs. The rats were observed for a period of 14 days and then sacrificed and necropsied.

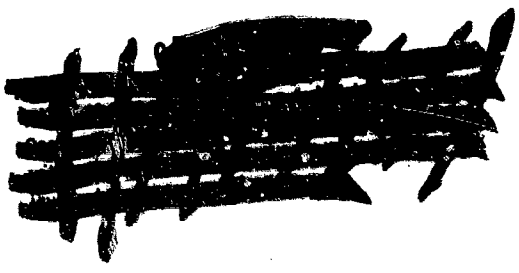
B. Compound Administration:

The rats were placed in a sealed 59.1 liter glass chamber and exposed for 4 continuous hours to a dynamic atmosphere containing pyrolysis products of the test compound. In order to prevent crowding during the exposure, the rats were separated into 4 units of two or three rats each.

The test chamber atmosphere was prepared by passing an airflow of 10 LPM through a 500 ml 3 necked flask (Pyrex No. 4950) containing ABS Resin/Sb_2O_3. The flask was immersed in an oil bath. Airflow through the flask was not initiated until the test compound temperature reached at least 450°F. Two 300 mm Liebig condensers

(Pyrex No. 2400) were used in line between the flask and exposure chamber. Throughout the 4 hour exposure period, the temperature of the oil bath was monitored at from 490 to 495°F; the test compound at from 460 to 465°F; and the atmosphere of the exposure chamber at from 67 to 70°F.

The flask containing the test compound was weighed before exposure. However, after pyrolysis, the test compound had become brittle and adhered to the inside surface of the pyrex flask. Upon cooling, before weighing, the flask shattered. The reaction occurred following both the original test run and also a second run. It is assumed that the flask shattered due to a difference in the coefficients of expansion of the glass flask and the brittle test compound upon cooling. Due to this occurrence it was not possible to obtain an accurate post-exposure weight of the compound flask, and therefore, a percent weight loss could not be calculated.



IV. RESULTS:

A. Pharmacodynamic Signs:

All of the rats exposed to the pyrolysis products of the test compound survived the 4 hour exposure period, and also the subsequent 14 day observation period.

Signs observed during the 4 hour exposure period included decreased motor activity, eye squint, slight dyspnea, ocular porphyrin discharge and lacrimation.

At 24, 48 and 72 hours, respiratory congestion and drying of the corneal surface were observed. In addition, one rat exhibited corneal opacity at 48 hours.

From 4 through 7 days, drying of the corneal surface, corneal opacity, corneal lesions and soft stool were observed in several rats. On days 8 through 14, a few rats continued to exhibit corneal opacity and corneal lesions. In addition, soft stool was observed in one or two rats on days 8, 9, 13 and 14.

All rats exhibited normal body weight gains during the study period.

B. Necropsy Findings:

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 2 of 10 rats showing petechiation of the lungs.

CN-100-680

8EHQ-0678-0184

International Research and Development Corporation

FM 680

0184 (Q)

SPONSOR: Michigan Chemical Corporation

COMPOUND: ABS Resin/FM 680/Sb_2O_3

SUBJECT: Acute Inhalation Toxicity in the Albino Rat After Pyrolysis.

MAY 0508

1. What was tested?
2. Method for calculating concentration not acceptable. How much substance condensed in the chamber & in animal fur in going from 46°F to 66°F?
3. Upper respiratory tract mucosal and ocular irritant. Ocular porphyrin discharge (chromodacryorrhea) + diarrhea suggests vagus nerve stimulation.

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Aug 8, 1978

Collaborators:

Dr. R. G. Geil, D.V.M.,
Vice President - Director
of Pathology

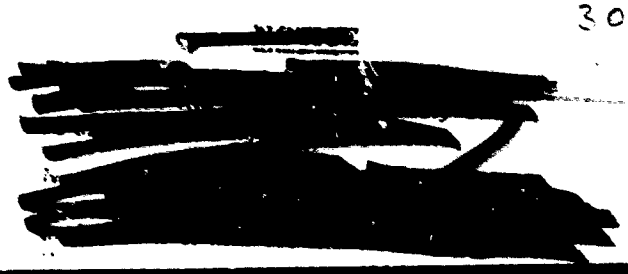
W. P. Dean

Date: March 12, 1975

300

134-039

Document declassified
8-22-78



0268

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	B. Necropsy Findings	5

0 2 6 9

PAGE 0510

I. SYNOPSIS

ABS Resin/FM 680/Sb_2O_3 was evaluated for acute inhalation toxicity in albino rats after pyrolysis. No deaths occurred during the 4 hour exposure period or during the subsequent 14 day period of observation.

The pharmacodynamic and/or toxic signs observed are recorded in the body of this report.

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 1 of 10 rats showing scattered grey foci in the lungs and 1 of 10 rats which exhibited congestion of the lungs.

II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on November 29, 1974. It was identified as "ABS Resin/FM 680/Sb_2O_3, Lot No. 607-43-G" and was received as off-white, small cylindrical chunks.

MSC 05111

RAF 0512

III. METHOD:

A. General Procedure:

Five male and 5 female albino rats of the Spartan strain, weighing from 203 to 239 grams, were exposed to an atmosphere containing pyrolysis products of the test material.

The rats were housed by sex in groups of 5 rats each in wire mesh cages elevated above the droppings and maintained in temperature and humidity controlled quarters throughout the pre-exposure and post-exposure periods. Food and water were available ad libitum.

During the 4 hour exposure the rats were observed for changes in behavior and/or appearance. Immediately following the exposure, they were examined closely for pharmacodynamic and/or toxic signs. The rats were observed for a period of 14 days and then sacrificed and necropsied.

B. Compound Administration:

The rats were placed in a sealed 59.1 liter glass chamber and exposed for 4 continuous hours to a dynamic atmosphere containing pyrolysis products of the test compound. In order to prevent crowding during the exposure, the rats were separated into 4 units of two or three rats each.

The test chamber atmosphere was prepared by passing an airflow of 10 LPM through a 500 ml 3 necked flask (Pyrex No. 4950) containing 100.02 grams of ABS Resin/FM 680/Sb_2O_3. The flask was immersed in an oil bath. Airflow through the flask was not initiated until the test compound temperature reached at least 450°F.

Two 300 mm Liebig condensers (Pyrex No. 2400) were used in line between the flask and exposure chamber. Throughout the 4 hour exposure period, the temperature of the oil bath was monitored at from 485 to 500°F; the test compound at from 450 to 464°F; and the atmosphere of the exposure chamber at from 68 to 69°F.

The flask containing the test compound was weighed before and after the exposure and sent to the sponsor. From this data the percent weight loss was calculated.

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MR 05-4

IV. RESULTS:

A. Pharmacodynamic Signs:

All rats exposed to the pyrolysis products of the test compound survived the 4 hour exposure period, and also the subsequent 14 day observation period.

Signs observed during the 4 hour exposure period included decreased motor activity, eye squint, slight dyspnea, and ocular porphyrin discharge.

At 24 hours, eye squint and ocular porphyrin discharge were observed in several rats. From 48 hours through 14 days, most rats appeared normal. Signs that were observed included one or two rats exhibiting soft stool at 48 hours and 8, 10, 12, 13 and 14 days; one rat exhibiting respiratory congestion at 8, 9, 12 and 13 days; and one rat exhibiting ocular lesions from 48 hours through 7 days.

All rats exhibited normal body weight gains during the study period.

The percent weight loss of compound in the flask, after pyrolysis, at 4 hours was calculated to be 2.45 percent.

B. Necropsy Findings:

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 1 of 10 rats showing scattered grey foci in the lungs and 1 of 10 rats which exhibited congestion of the lungs.

0 3 7 4

SPONSOR: Michigan Chemical Corporation

COMPOUND: ABS Resin/Sb_2O_3

SUBJECT: Acute Inhalation Toxicity in the Albino Rat After Pyrolysis.

PAGE 0515

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborators:

Dr. R. G. Geil, D.V.M.,
Vice President - Director
of Pathology

W. P. Dean

Date: March 12, 1975

134-038

[redacted]

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1. SYNOPSIS

ABS Resin/Sb_2O_3 was evaluated for acute inhalation toxicity in albino rats after pyrolysis. No deaths occurred during the 4 hour exposure period or during the subsequent 14 day period of observation.

The pharmacodynamic and/or toxic signs observed are recorded in the body of this report.

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 2 of 10 rats showing petechiation of the lungs.

II. COMPOUND

The test compound was received from the Michigan Chemical Corporation, St. Louis, Michigan on November 29, 1974. It was identified as "ABS Resin/Sb_2O_3, Lot No. 607-43-D" and was received as off-white, small cylindrical chunks.

MAE 0518

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III. METHOD:

A. General Procedure:

Five male and 5 female albino rats of the Spartan strain, weighing from 238 to 278 grams, were exposed to an atmosphere containing pyrolysis products of the test material.

The rats were housed by sex in groups of 5 rats each in wire mesh cages elevated above the droppings and maintained in temperature and humidity controlled quarters throughout the pre-exposure and post-exposure periods. Food and water were available ad libitum.

During the 4 hour exposure the rats were observed for changes in behavior and/or appearance. Immediately following the exposure, they were examined closely for pharmacodynamic and/or toxic signs. The rats were observed for a period of 14 days and then sacrificed and necropsied.

B. Compound Administration:

The rats were placed in a sealed 59.1 liter glass chamber and exposed for 4 continuous hours to a dynamic atmosphere containing pyrolysis products of the test compound. In order to prevent crowding during the exposure, the rats were separated into 4 units of two or three rats each.

The test chamber atmosphere was prepared by passing an airflow of 10 LPM through a 500 ml 3 necked flask (Pyrex No. 4950) containing ABS Resin/Sb_2O_3. The flask was immersed in an oil bath. Airflow through the flask was not initiated until the test compound temperature reached at least 450°F. Two 300 mm Liebig condensers

PAGE 0520

IV. RESULTS:

A. Pharmacodynamic Signs:

All of the rats exposed to the pyrolysis products of the test compound survived the 4 hour exposure period, and also the subsequent 14 day observation period.

Signs observed during the 4 hour exposure period included decreased motor activity, eye squint, slight dyspnea, ocular porphyrin discharge and lacrimation.

At 24, 48 and 72 hours, respiratory congestion and drying of the corneal surface were observed, In addition, one rat exhibited corneal opacity at 48 hours.

From 4 through 7 days, drying of the corneal surface, corneal opacity, cornea. lesions and soft stool were observed in several rats. On days 8 through 14, a few rats continued to exhibit corneal opacity and corneal lesions. In addition, soft stool was observed in one or two rats on days 8, 9, 13 and 14.

All rats exhibited normal body weight gains during the study period.

B. Necropsy Findings:

Necropsy findings observed at terminal necropsy conducted at 14 days revealed 2 of 10 rats showing petechiation of the lungs.

0184 (R)
8EHQ-0678-0184

International Research and Development Corporation

PAGE 0521

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster 680

SUBJECT: Fourteen Day Range Finding Study in Rats.

This is a pilot study and not 8e material
Joseph Gaylor
Aug 8, 1978

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborator:

B. W. Benson, B.S., Director of
Small Animal Toxicology

Document declassified 8-22-78

Date: April 10, 1975

134-053

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0281

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134-053

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0282

I. SYNOPSIS

In a 14 day range finding study in Charles River CD rats, Firemaster 680 was fed in the diet at dosage levels of 0.5, 1.0, 5.0 and 10.0%. Five male and 5 female rats were used at each dosage level. The rats were observed daily. Body weights and food consumption were recorded weekly.

No changes considered to be related to compound were seen in general behavior and appearance, body weights or food consumption. One rat at the 5.0% dosage level died during the study.

No compound related gross pathologic lesions were observed at necropsy in any rats.

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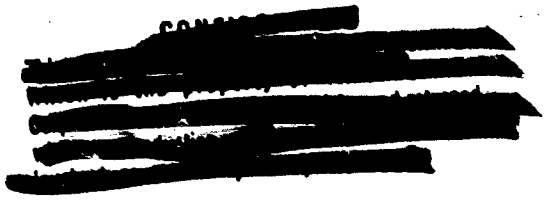

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II. COMPOUND

The compound was received from Michigan Chemical Corporation, St. Louis, Michigan on October 17, 1974. The compound was a white powder and was identified as "Firemaster® 680, Lot No. 761-7".

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III. CLINICAL STUDIES

A. METHOD:

1. General Procedure:

Twenty male (weighing from 85 to 128 grams) and 20 female (weighing from 76 to 104 grams) Charles River CD rats were used in this study. The rats were housed individually in hanging wire mesh cages and maintained in a temperature and humidity controlled room. Powdered Purina Laboratory Chow and water were available ad libitum.

Following 14 days of compound administration, all of the rats were sacrificed and necropsied.

2. Compound Administration:

Firemaster 680 was administered in the diet at dosage levels of 0.5, 1.0, 5.0 and 10.0%. Five male and 5 female rats were used at each dosage level. The compound was mixed with the basal laboratory diet in a twin shell blender.

3. Observations:

The rats were observed daily for changes in general behavior and appearance. Individual body weights and sex group food consumptions were recorded weekly.

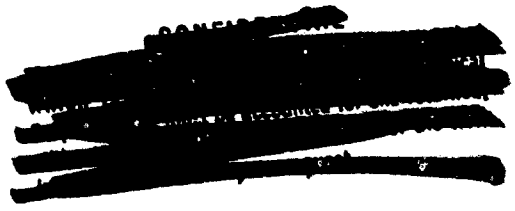
B. RESULTS:

1. General Behavior, Appearance and Survival:

No changes considered to be related to compound were seen in general behavior and appearance. One male rat at the 5.0% dosage level died during the study.

2. Body Weights (Tables 1-2):

No changes considered to be related to compound were seen in body weights.



3. Food Consumption (Table 3):

No changes considered to be related to compound were seen in food consumption values.

4. Necropsy Findings:

No gross pathologic lesions considered to have been compound related were seen at necropsy in any of the rats. Gross lesions observed included yellow or dark red pinpoint lung foci in 2 rats from the 0.5% level, hydrometra in 1 rat each from the 0.5 and 10% levels and unilateral hydronephrosis in 1 rat from the 5% level. These lesions all are of common spontaneous occurrence in rats. No cause of death could be determined for the rat which died at the 5% level.

PAGE 0526

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Corporation. It must be [redacted]he work
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Firemaster 680: Fourteen Day Range Finding Study in Rats.

TABLE 1. Group Mean Body Weights, Grams; Weight Ranges; Survival.

Compound Administration Week	0.5% Mean Body Wt.	0.5% Weight Ranges	0.5% Survival	1.0% Mean Body Wt.	1.0% Weight Ranges	1.0% Survival	5.0% Mean Body Wt.	5.0% Weight Ranges	5.0% Survival	10.0% Mean Body Wt.	10.0% Weight Ranges	10.0% Survival
MALE:												
0	109	96-128	5/5	109	98-120	5/5	109	101-119	5/5	109	85-118	5/5
1	167	154-191	5/5	166	154-180	5/5	169	161-187	5/5	166	138-178	5/5
2	224	206-230	5/5	218	212-228	5/5	227	218-250	4/5	225	199-240	5/5
FEMALE:												
0	86	76-104	5/5	86	78-92	5/5	86	80-101	5/5	86	76-93	5/5
1	129	118-147	5/5	134	126-140	5/5	133	120-151	5/5	130	116-137	5/5
2	169	150-193	5/5	171	167-175	5/5	168	160-180	5/5	167	149-183	5/5

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Firemaster 680: Fourteen Day Range Finding Study in Rats.

TABLE 2. Individual Weekly Body Weights, Grams.

Group, Rat No.	Sex	Control 0	Compound Administration Weeks 1	2
0.5%:				
21894	M	103	159	206
21895	M	109	160	220
21896	M	109	169	230
21897	M	96	154	208
21898	M	128	191	258
21899	F	104	147	193
21900	F	78	118	150
21901	F	80	122	168
21902	F	76	118	157
21939	F	90	142	178
1.0%:				
21904	M	103	158	212
21905	M	112	167	213
21907	M	120	180	228
21908	M	111	169	224
21935	M	98	154	214
21909	F	78	126	171
21910	F	92	140	171
21911	F	85	134	172
21912	F	89	137	175
21913	F	86	132	167
5.0%:				
21914	M	101	161	220
21915	M	101	159	218
21917	M	118	187	250
21918	M	19	175	Died
21927	M	107	162	218
21919	F	101	151	180
21921	F	80	128	164
21922	F	85	136	177
21923	F	85	129	160
21940	F	81	120	160
10.0%:				
21916	M	85	138	199
21924	M	110	170	229
21925	M	118	178	240
21926	M	116	171	227
21936	M	115	171	230
21929	F	76	116	149
21930	F	93	135	183
21932	F	86	133	176
21933	F	88	129	162
21938	F	88	137	165

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0288

Firemaster 680: Fourteen Day Range Finding Study in Rats.

TABLE 3. Mean Food Consumption, Grams/Rat/Day and Grams/Kilogram/Day.

Compound Administration Weeks	0.5% Gm/Rat/Day	0.5% Gm/Kg/Day	1.0% Gm/Rat/Day	1.0% Gm/Kg/Day	5.0% Gm/Rat/Day	5.0% Gm/Kg/Day	10.0% Gm/Rat/Day	10.0% Gm/Kg/Day
MALE:								
1	20.2	121.1	20.9	126.2	23.3	137.8	21.9	131.8
2	24.5	109.4	24.9	114.2	29.3	129.1	26.5	117.8
FEMALE:								
1	18.0	139.8	18.4	137.1	19.5	146.3	18.9	145.1
2	20.4	120.7	21.2	124.0	22.5	133.9	22.6	135.3

0529

88-1000184

8END-0678-0184 (5)

International Research and Development Corporation

SPONSOR: Michigan Chemical Corporation

COMPOUND: Firemaster 680

SUBJECT: Twenty Eight Day Toxicity Study in Rats.

This study shows that FM680 is absorbed and stored in fat tissue. The small amounts (4-5 times normal) stored with short term administration are moded and eliminated. This complements 0184(5) so far as storage is concerned.

Aug 9, 1978

Francis X. Wazeter, Ph.D.
President

Edwin I. Goldenthal, Ph.D.
Director of Research

Collaborators:

R. G. Geil, D.V.M., Director of Pathology
B. W. Benson, B.S., Director of Small Animal Toxicology

Document declassified 8-22-78

Date: May 19, 1975

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CONFIDENTIAL

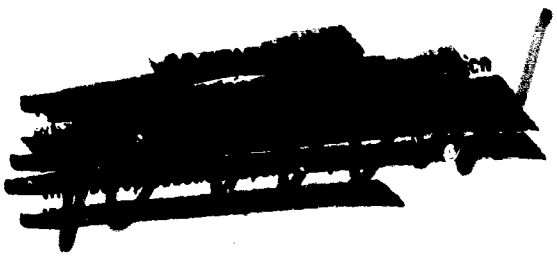
0291

0538

I. SYNOPSIS

In a 28 day study in Charles River CD rats, Firemaster 680 was fed in the diet at a dosage level of 1000 ppm. Twenty-five male and 25 female rats were used at this dosage level and also in a control group. The rats were observed daily and body weights and food consumption were recorded weekly. Following 4 weeks of compound administration all of the rats were placed into compound withdrawal. Fat and liver samples obtained from 5 male and 5 female rats sacrificed from each group after 4 weeks of compound administration and after 6 weeks of compound withdrawal were analyzed for bromine content. Fat samples obtained from 5 male and 5 female rats sacrificed from each group after 12 and 18 weeks of compound withdrawal were analyzed for bromine content.

No changes considered to be related to compound were seen in general behavior or appearance, body weight, food consumption or survival. Slight increases in bromine content were found in the fat samples from the treated rats following 4 weeks of compound administration. There was a reduction in the bromine content of the fat samples of treated rats at each interval of analysis during the compound withdrawal period. After 18 weeks of withdrawal the bromine content of fat from treated rats was considered to be within normal limits.



II. COMPOUND

The compound was received from Michigan Chemical Corporation, St. Louis, Michigan as indicated below:

Date Received	Label	Description
August 22, 1974	"Firemaster 680 Lot No. 761-7"	white powder
October 17, 1974	"Firemaster® 680 Lot No. 761-7"	white powder

0293

III. CLINICAL STUDIES

A. METHOD:

1. General Procedure:

Fifty male (weighing from 192 to 233 grams) and 50 female (weighing from 147 to 176 grams) Charles River CD rats were used in this study. The rats were housed individually in hanging wire mesh cages and maintained in a temperature and humidity controlled room during the study. Powdered Purina Laboratory Chow and water were available ad libitum.

2. Compound Administration:

Firemaster 680 was fed in the diet to 25 male and 25 female rats at a dosage level of 1000 ppm. Twenty-five male and 25 female control rats were fed the basal diet only on the same regimen as treated rats. The compound was mixed with the basal diet fresh weekly in a twin shell blender. Following 4 weeks of compound administration, the rats were placed into compound withdrawal.

3. Observations:

The rats were observed daily for changes in general behavior and appearance. Individual body weights and sex group food consumption were recorded weekly.

4. Bromine Analysis:

Five male and 5 female rats from each group were sacrificed after 4 weeks of compound administration and after 6, 12 and 18 weeks of compound withdrawal. Samples of liver and fat from all of the rats sacrificed were frozen. Liver samples obtained after 4 weeks of compound and after 6 weeks of compound withdrawal were analyzed for bromine. Fat samples obtained at all of the sacrifice intervals were analyzed for bromine. Bromine analysis was done by neutron activation.

B. RESULTS:

1. General Behavior, Appearance and Survival:

No changes considered to be related to compound were seen in general behavior and appearance. No rats died during the study.

2. Body Weight (Tables 1-2):

Increases in body weight were similar for control and treated rats.

3. Food Consumption (Table 3):

Food consumption values were similar for control and treated rats.

4. Bromine Analysis (Table 4):

Slight increases in bromine content were found in the fat samples from the treated rats following 4 weeks of compound administration. The bromine content in the fat of treated rats was lower at each interval of analysis during the compound withdrawal period. After 18 weeks of withdrawal the bromine content of fat from treated rats was considered to be within normal limits.

The sex group mean values for bromine content are shown on the following page.

Sex Group Mean Values for Bromine Content, ppm

	Liver	Fat
4 weeks compound		
Control, male	4.0	1.3
female	3.9	1.4
1000 ppm, male	5.0	4.1
female	5.1	5.3
6 weeks withdrawal		
Control, male	3.2	1.7
female	4.0	1.3
1000 ppm, male	3.8	3.2
female	3.7	3.8
12 weeks withdrawal		
Control, male		0.65
female		0.74
1000 ppm, male		1.88
female		2.16
18 weeks withdrawal		
Control, male		0.82
female		1.06
1000 ppm, male		1.05
female		1.79

Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 1. Males: Mean Body Weights, Grams; Weight Ranges and Survival.

Compound Administration Weeks	Control			1000 ppm		
	Mean Body Wt.	Weight Ranges	Survival	Mean Body Wt.	Weight Ranges	Survival
-1	174	144-187	25/25	171	148-186	25/25
0	213	192-233	25/25	213	194-227	25/25
1	259	225-294	25/25	262	232-288	25/25
2	303	241-335	25/25	296	261-331	25/25
3	322	268-362	25/25	325	287-366	25/25
4	346	263-397	25/25	353	306-405	25/25
Compound Withdrawal Weeks						
1	362	285-413	20/25	373	325-431	20/25
2	380	308-436	20/25	389	346-450	20/25
3	394	323-463	20/25	404	350-478	20/25
4	407	333-493	20/25	419	360-499	20/25
5	417	340-509	20/25	432	371-513	20/25
6	423	344-519	20/25	442	388-530	20/25
7	430	351-543	15/25	452	388-546	15/25
8	439	359-544	15/25	469	399-563	15/25
9	443	363-550	15/25	471	402-567	15/25
10	451	368-556	15/25	477	405-576	15/25
11	463	376-566	15/25	485	418-587	15/25
12	468	378-571	15/25	491	410-595	15/25
13	458	386-509	10/25	513	455-581	10/25
14	460	391-515	10/25	526	463-588	10/25
15	464	393-528	10/25	526	462-615	10/25
16	469	402-525	10/25	529	464-625	10/25
17	476	400-531	10/25	536	469-592	10/25
18	480	410-531	10/25	543	473-660	10/25

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Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 1. Cont. Females: Mean Body Weights, Grams; Weight Ranges and Survival.

Compound Administration Weeks	Control			1000 ppm		
	Mean Body Wt.	Weight Ranges	Survival	Mean Body Wt.	Weight Ranges	Survival
-1	142	123-155	25/25	145	122-178	25/25
0	164	151-175	25/25	164	147-176	25/25
1	184	167-206	25/25	184	165-202	25/25
2	200	178-226	25/25	199	175-222	25/25
3	212	183-240	25/25	208	175-226	25/25
4	223	195-251	25/25	222	195-247	25/25
Compound Withdrawal Weeks						
1	228	202-247	20/25	231	204-254	20/25
2	237	207-256	20/25	235	204-257	20/25
3	241	205-264	20/25	237	205-264	20/25
4	243	212-269	20/25	245	216-271	20/25
5	249	213-281	20/25	247	217-271	20/25
6	245	215-269	20/25	252	218-275	20/25
7	250	219-280	15/25	253	219-277	15/25
8	254	224-284	15/25	260	233-288	15/25
9	254	220-281	15/25	256	229-281	15/25
10	257	230-289	15/25	257	226-283	15/25
11	261	232-295	15/25	262	233-287	15/25
12	262	230-300	15/25	262	230-288	15/25
13	264	240-280	10/25	262	238-293	10/25
14	267	241-285	10/25	267	242-294	10/25
15	268	241-288	10/25	266	238-293	10/25
16	271	248-290	10/25	271	245-294	10/25
17	274	251-290	10/25	273	246-300	10/25
18	278	249-300	10/25	276	245-304	10/25

Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 2. Individual Body Weights, Grams.

Group, Rat No.	Sex	Control -1	Control 0	Compound Admin. Weeks 1	2	3	4	Compound Withdrawal Weeks 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Control:																									
20199	M	184	227	278	313	347	379	Sacrificed																	
20200	M	182	233	294	294	360	397	Sacrificed																	
20201	M	144	210	261	298	326	366	Sacrificed																	
20202	M	171	213	267	305	334	360	Sacrificed																	
20203	M	187	220	264	298	325	359	Sacrificed																	
20204	M	178	217	268	311	350	375	400	423	440	457	462	472	Sacrificed											
20205	M	154	192	230	258	283	303	320	338	354	366	378	374	Sacrificed											
20206	M	171	206	261	297	331	360	383	410	410	424	431	431	Sacrificed											
20207	M	176	215	273	317	350	375	398	421	441	459	483	491	Sacrificed											
20208	M	167	204	242	281	310	333	356	375	388	400	403	407	Sacrificed											
20209	M	167	194	225	244	269	282	304	317	325	338	342	355	368	378	385	390	406	410	Sacrificed					
20210	M	183	226	274	303	334	358	381	402	418	431	445	455	453	477	480	482	494	501	Sacrificed					
20211	M	187	231	287	335	362	384	413	436	463	493	509	519	543	544	550	556	566	571	Sacrificed					
20212	M	179	217	270	310	350	382	405	424	450	470	476	483	481	503	490	511	529	545	Sacrificed					
20213	M	182	215	256	280	325	350	377	392	409	423	430	437	441	455	453	468	480	489	Sacrificed					
20214	M	184	224	268	297	321	344	361	372	381	383	400	404	420	428	435	446	462	470	479	476	478	485	496	499
20301	M	177	212	260	296	322	350	372	387	398	397	406	418	428	435	439	443	450	455	460	460	457	467	472	480
20216	M	177	217	267	308	331	362	387	394	405	413	424	429	440	449	452	460	465	475	483	479	484	490	498	503
20217	M	176	217	260	292	319	345	366	381	394	408	411	414	433	437	443	453	467	474	477	478	490	490	498	499
20218	M	182	206	227	241	268	263	285	308	323	333	340	344	351	359	363	368	376	378	386	391	393	402	400	410
20219	M	167	196	237	264	296	308	330	349	358	371	381	385	398	402	410	416	425	427	434	436	440	442	451	454
20220	M	177	222	273	311	336	365	386	407	423	439	450	463	477	487	488	488	508	505	509	515	528	523	531	531
20221	M	155	195	232	260	284	296	313	331	342	351	351	355	370	369	379	387	397	401	410	412	421	426	432	432
20222	M	163	199	241	268	290	314	335	360	372	383	391	393	405	412	420	432	438	442	447	451	453	455	464	470
20223	M	177	218	268	291	317	344	360	376	387	405	418	426	439	448	449	466	479	480	493	500	496	503	513	518
20224	F	135	174	198	218	238	251	Sacrificed																	
20225	F	148	171	206	226	240	250	Sacrificed																	
20226	F	146	156	176	189	205	210	Sacrificed																	
20227	F	141	158	176	184	206	212	Sacrificed																	
20228	F	123	151	167	190	209	218	Sacrificed																	
20229	F	149	173	194	214	223	235	244	252	263	265	268	260	Sacrificed											
20230	F	144	153	179	196	210	216	230	236	241	241	251	254	Sacrificed											
20240	F	143	174	192	211	225	230	234	247	246	244	248	249	Sacrificed											
20232	F	150	174	190	204	224	237	247	251	264	254	281	269	Sacrificed											
20233	F	153	175	196	212	230	240	242	256	260	261	266	263	Sacrificed											
20234	F	138	157	173	202	186	200	207	207	213	213	213	215	224	224	220	230	232	230	Sacrificed					
20235	F	148	171	187	205	221	234	242	250	264	269	268	266	280	284	281	289	295	300	Sacrificed					
20236	F	142	172	184	197	217	242	226	238	248	253	254	251	263	268	266	270	276	280	Sacrificed					
20237	F	138	158	173	181	183	195	202	200	205	212	217	217	219	230	230	230	233	233	Sacrificed					
20238	F	136	153	167	178	188	200	206	212	223	224	230	226	236	233	242	242	247	248	Sacrificed					
20239	F	142	161	180	188	196	203	214	219	216	222	226	221	227	234	232	236	237	242	240	241	241	248	251	249
20240	F	142	163	183	202	217	228	237	246	248	247	253	249	259	260	255	259	260	264	265	264	264	264	263	276
20241	F	138	169	191	206	215	221	235	242	246	247	255	256	267	266	276	272	276	274	278	285	279	278	290	296
20242	F	135	161	172	185	202	211	213	225	234	234	236	234	248	245	250	248	257	258	256	253	253	253	255	265
20243	F	137	162	188	201	211	225	233	243	242	244	253	247	255	257	259	263	263	262	261	265	269	274	280	276
20244	F	144	161	178	198	210	219	226	243	250	251	252	256	267	269	266	273	278	280	280	284	288	285	285	300
20245	F	142	165	185	201	210	221	233	242	236	246	254	247	257	270	266	270	277	276	274	277	288	290	287	290
20246	F	123	151	188	210	220	226	231	244	244	247	251	245	253	251	252	256	257	259	258	254	264	269	275	277
20247	F	145	165	190	208	220	222	227	236	227	244	245	233	250	250	250	252	256	257	261	259	260	262	268	266
20248	F	149	172	188	202	208	223	237	243	242	250	261	247	249	266	265	265	264	273	271	279	273	282	281	286

This document contains confidential information involved in [redacted] Chemical Corporation [redacted]

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Firemaster 680:

Twenty-Eight Day Toxicity Study in Rats.

TABLE 2. Continued.

Individual Body Weights, Grams.

Group, Rat No.	Sex	Control -1	Control 0	Compound Admin. Weeks 1	2	3	4	Compound Withdrawal Weeks 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1,000 ppm:																									
20249	M	176	214	264	293	322	360	Sacrificed																	
20250	M	171	212	267	293	322	348	Sacrificed																	
20251	M	171	212	258	286	314	349	Sacrificed																	
20299	M	162	202	251	286	315	341	Sacrificed																	
20303	M	167	203	251	290	325	350	Sacrificed																	
20254	M	171	222	276	302	330	319	331	363	389	399	400	418	Sacrificed											
20255	M	171	211	257	294	327	347	370	383	396	419	443	423	Sacrificed											
20256	M	180	221	266	290	325	352	371	392	400	418	431	434	Sacrificed											
20257	M	162	200	243	282	311	340	370	388	398	406	417	417	Sacrificed											
20258	M	176	221	267	308	333	362	376	397	406	421	437	446	Sacrificed											
20259	M	186	227	276	305	326	343	356	369	389	400	409	421	428	450	452	465	478	480	Sacrificed					
20260	M	164	212	261	302	322	355	377	388	392	411	416	428	443	448	451	451	464	477	Sacrificed					
20261	M	163	194	232	261	287	306	325	338	350	360	371	388	388	399	402	405	418	410	Sacrificed					
20262	M	165	202	247	274	298	322	330	349	361	372	381	391	406	417	426	430	437	442	Sacrificed					
20263	M	162	206	252	297	323	350	366	381	397	401	413	431	436	449	452	460	467	459	Sacrificed					
20264	M	172	222	284	330	359	405	431	450	477	495	508	530	546	563	567	576	587	595	568	588	615	625	642	650
20265	M	171	211	274	324	366	405	423	450	478	499	513	529	536	559	554	567	571	581	581	587	592	600	614	618
20266	M	182	225	280	305	340	378	400	417	436	447	463	478	467	509	500	502	513	515	527	530	538	541	540	551
20267	M	171	213	261	292	316	340	358	380	398	413	428	444	410	448	461	459	482	487	507	510	520	528	537	542
20268	M	177	226	288	331	362	394	420	445	471	487	499	512	525	539	544	549	553	578	569	573	580	589	592	596
20269	M	184	220	263	299	325	350	373	394	407	428	442	447	451	467	467	474	477	480	491	493	498	490	499	506
20270	M	172	211	258	295	321	346	368	346	384	402	415	422	419	429	435	445	446	450	455	559	462	464	469	473
20271	M	148	214	261	288	319	349	370	395	409	420	436	449	454	468	469	474	487	495	506	485	513	512	513	522
20272	M	177	216	266	292	320	353	370	377	350	376	397	403	418	433	432	436	446	457	469	470	468	473	484	490
20273	M	178	212	251	287	314	344	366	384	393	400	419	425	432	450	446	449	453	458	457	463	473	480	474	477
20274	F	138	163	193	211	216	231	Sacrificed																	
20275	F	146	161	178	191	207	217	Sacrificed																	
20276	F	132	147	165	181	189	195	Sacrificed																	
20277	F	149	167	184	196	200	215	Sacrificed																	
20278	F	141	176	202	222	226	246	Sacrificed																	
20279	F	137	159	174	184	193	208	212	220	222	226	232	232	Sacrificed											
20280	F	143	165	187	198	215	222	231	232	227	240	246	250	Sacrificed											
20281	F	146	164	184	196	208	218	222	225	205	231	234	241	Sacrificed											
20282	F	143	161	184	204	215	233	240	245	250	258	266	265	Sacrificed											
20283	F	148	171	195	214	225	244	251	257	257	260	267	275	Sacrificed											
20284	F	147	164	172	138	193	211	217	219	215	227	223	232	234	233	234	235	245	234	Sacrificed					
20285	F	152	172	188	202	205	220	235	241	242	253	256	258	253	265	262	262	267	266	Sacrificed					
20286	F	153	170	196	212	226	236	249	252	256	262	261	264	265	278	271	273	275	277	Sacrificed					
20287	F	148	167	188	199	213	229	237	242	255	255	241	257	267	274	273	272	280	284	Sacrificed					
20288	F	145	168	194	210	224	237	245	253	258	264	268	271	277	279	281	280	287	284	Sacrificed					
20289	F	147	171	195	209	215	228	236	240	244	250	252	253	252	258	253	250	255	255	262	265	272	273	273	269
20312	F	178	162	182	196	208	218	225	230	235	234	233	241	242	247	243	245	249	248	252	251	253	258	264	273
20291	F	138	157	171	188	175	204	213	223	232	233	229	243	247	250	245	251	258	255	256	265	269	270	272	277
20292	F	148	167	181	187	196	202	207	211	207	216	217	218	219	236	230	226	233	230	241	254	243	248	249	245
20293	F	122	152	171	185	190	206	215	219	223	235	239	238	246	247	243	240	249	248	254	255	254	261	269	268
20294	F	151	172	197	210	231	247	252	252	264	271	274	275	277	278	276	279	285	288	270	291	293	300	299	304
20295	F	144	164	191	209	227	231	234	255	261	267	266	279	277	288	278	283	285	280	289	294	293	289	300	303
20296	F	147	164	182	197	209	226	237	242	243	255	262	268	263	278	273	273	276	282	293	292	288	294	286	302
20297	F	140	156	168	175	190	200	204	204	213	224	222	227	227	237	229	230	234	238	238	242	238	245	246	246
20298	F	136	161	182	202	205	220	229	236	235	248	252	254	251	259	254	254	255	257	265	265	261	268	272	273

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Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 3. MALE RATS: Mean Food Consumption, Grams/Rat/Day and Grams/Kilograms/Day.

Compound Administration Weeks	Control		1,000 ppm	
	Gm/ Rat/ Day	Gm/ Kg/ Day	Gm/ Rat/ Day	Gm/ Kg/ Day
0	20.9	98.1	20.0	93.9
1	23.9	92.3	23.2	88.5
2	24.4	80.5	23.8	80.4
3	24.0	74.5	25.0	76.9
4	24.7	71.4	23.4	66.3
Compound Withdrawal Weeks				
1	24.1	66.6	23.9	64.1
2	24.0	63.2	24.8	63.8
3	25.0	63.5	24.2	59.9
4	23.5	57.7	24.7	58.9
5	22.9	54.9	26.2	60.6
6	*			
7	23.8	55.3	27.7	61.3
8	23.3	53.1	24.8	52.9
9	23.4	52.8	25.2	53.5
10	24.8	55.0	25.2	52.8
11	23.9	51.6	25.6	52.8
12	23.6	50.4	22.8	46.4
13	23.0	50.2	25.1	48.9
14	22.9	49.8	26.8	51.0
15	22.4	48.3	25.8	49.0
16	24.2	51.6	26.3	49.7
17	22.3	46.8	26.7	49.8
18	22.4	46.7	27.5	50.6

*cannot calculate

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Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 3. Cont. FEMALE RATS: Mean Food Consumption, Grams/Rat/Day and Grams/Kilograms/Day.

Compound Administration Weeks	Control		1,000 ppm	
	Gm/ Rat/ Day	Gm/ Kg/ Day	Gm/ Rat/ Day	Gm/ Kg/ Day
0	16.2	98.8	17.4	106.1
1	17.1	92.9	16.3	88.6
2	17.6	88.0	17.4	87.4
3	16.1	75.9	17.5	84.1
4	17.9	80.3	17.9	80.6
Compound Withdrawal Weeks				
1	21.4	93.9	17.7	76.6
2	17.9	75.5	17.2	73.2
3	18.4	76.3	16.7	70.5
4	16.9	69.5	16.9	69.0
5	17.1	68.7	17.6	71.3
6	*			
7	18.1	72.4	18.0	71.1
8	18.3	72.0	17.1	65.8
9	16.5	65.0	16.8	65.6
10	17.4	67.7	18.0	70.0
11	16.9	64.8	17.7	67.6
12	16.2	61.8	19.2	73.3
13	16.9	64.0	13.5	51.5
14	17.1	64.0	20.0	74.9
15	16.7	62.3	16.2	60.9
16	17.8	65.7	16.8	62.0
17	16.8	61.3	16.0	58.8
18	16.9	60.8	16.8	60.9

*cannot calculate

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Firemaster 680: Twenty-Eight Day Toxicity Study in Rats.

TABLE 4. Bromine Content, ppm

Group, Rat Number	Sex	Compound Administration Week 4 Liver	Compound Administration Week 4 Fat	Compound Withdrawal Weeks 6 Liver	Compound Withdrawal Weeks 6 Fat	Compound Withdrawal Weeks 12 Fat	Compound Withdrawal Weeks 18 Fat
Control:							
20199	M	3.1	2.9				
20200	M	3.9	1.2				
20201	M	3.2	0.2				
20202	M	5.3	1.5				
20203	M	4.4	0.9				
Mean		4.0	1.3				
20224	F	4.2	0.9				
20225	F	2.8	0.7				
20226	F	5.1	2.3				
20227	F	4.0	1.6				
20228	F	3.6	1.3				
Mean		3.9	1.4				
20304	M			2.7	1.0		
20205	M			3.1	2.8		
20206	M			2.7	0.2		
20207	M			4.4	1.9		
20208	M			3.2	2.5		
Mean				3.2	1.7		
20229	F			3.0	<0.2		
20230	F			5.6	1.3		
20310	F			2.6	1.6		
20232	F			5.2	1.6		
20233	F			3.8	1.9		
Mean				4.0	1.3		
20209	M					0.85	
20210	M					0.46	
20211	M					0.64	
20212	M					0.76	
20213	M					0.56	
Mean						0.65	
20234	F					0.51	
20235	F					0.59	
20236	F					0.95	
20237	F					1.39	
20238	F					0.24	
Mean						0.74	
20214	M						0.52
20301	M						0.82
21216	M						0.96
20217	M						0.94
20218	M						0.65
Mean							0.82
20239	F						1.22
20240	F						1.27
20241	F						1.07
20242	F						0.82
20243	F						0.90
Mean							1.06

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Dimethoate 680. Twenty-Eight Day Toxicity Study in Rats.

TABLE 4. Continued. Bromine Content, ppm

Group, Rat Number	Sex	Compound Administration Week 4 Liver	Compound Administration Week 4 Fat	Compound Withdrawal Weeks 6 Liver	Compound Withdrawal Weeks 6 Fat	Compound Withdrawal Weeks 12 Fat	Compound Withdrawal Weeks 18 Fat
1000 ppm:							
20249	M	5.7	4.4				
20250	M	4.9	4.5				
20251	M	8.0	5.7				
20299	M	3.1	3.9				
20303	M	3.2	2.0				
Mean		5.0	4.1				
20274	F	6.3	7.2				
20275	F	5.9	3.7				
20276	F	3.3	4.1				
20277	F	4.0	4.0				
20278	F	5.8	7.4				
Mean		5.1	5.3				
20254	M			5.4	5.8		
20255	M			4.5	1.1		
20256	M			4.0	1.8		
20257	M			1.6	2.7		
20258	M			3.6	4.4		
Mean				3.8	3.2		
20279	F			4.1	4.2		
20280	F			4.4	4.8		
20281	F			3.0	4.2		
20282	F			2.9	3.3		
20283	F			4.2	2.7		
Mean				3.7	3.8		
20259	M					1.89	
20260	M					2.84	
20261	M					1.44	
20262	M					1.92	
20263	M					1.32	
Mean						1.88	
20284	F					2.09	
20285	F					1.83	
20286	F					2.01	
20287	F					2.55	
20288	F					2.32	
Mean						2.16	
20264	M						0.28
20265	M						1.25
20266	M						0.97
20267	M						1.83
20268	M						0.92
Mean							1.05
20289	F						2.46
20291	F						1.40
20292	F						2.44
20293	F						0.85
20312	F						1.81
Mean							1.79

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Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

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STATUS REPORT TO

MICHIGAN CHEMICAL CORPORATION

BIODEGRADATION STUDY WITH ^{14}C-TAGGED MC-680

NOVEMBER 20, 1975

IBT NO. 632-07189

Document declassified on 8-2-78

[redacted]

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Industrial BIO-TEST *Laboratories, Inc.*
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

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November 20, 1975

Dr. F. A. Daniher, Manager
Research & Development
Michigan Chemical Corporation
1975 Green Road
Ann Arbor, Michigan 48105

Dear Dr. Daniher:

Re: IBT No. 632-07189 - Biodegradation Study with ^{14}C-Tagged MC-680

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC:bp

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which is [redacted] property of Velsicol Chemical
Corpo[redacted]ed.
[redacted] the work
[redacted]

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STATUS REPORT TO

MICHIGAN CHEMICAL CORPORATION

BIODEGRADATION STUDY WITH ^{14}C-TAGGED MC-680

NOVEMBER 20, 1975

IBT NO. 632-07189

I. Introduction

A sample of ^{14}C-labeled MC-680 with a specific activity of 34 microcuries(μc) per mg was prepared by Amersham/Searle Corporation.

At the request of Michigan Chemical Corporation a biodegradation study was initiated to determine biodegradability of the flame-retardant material MC-680. The status report describes the test procedures and presents the results obtained during 7 weeks of testing. The test material is presently being tested at 3 different concentrations using a simple shake flask system to monitor CO_2 liberation.

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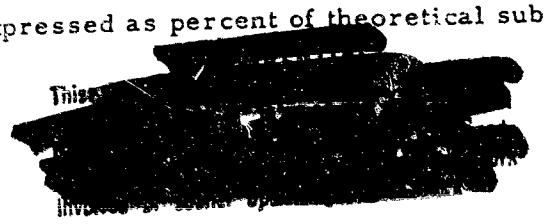
II. Summary

Tests of aerobic biodegradability are presently conducted by exposing ^{14}C-tagged MC-680 to acclimated sewage and garden soil microorganisms in a shake flask system. Each reaction flask (125 ml Erlenmeyer flask) is equipped with a small center cup containing the KOH-Solution for absorption of the respired $^{14}CO_2$ due to biodegradation of the labeled test material by the microorganisms present. The current experiment is now in progress for a period of 8 weeks for test groups I and II, and 4 weeks for test group III, not including previous microbial acclimation.

During an 18 day acclimation period microorganisms derived from sewage and garden soil were exposed to nonlabeled MC-680. The adapted bacterial seed organisms were then used to prepare the test media. Three different concentrations of ^{14}C-tagged test material in microbial media were prepared (1.0 and 0.01 percent, and 1.0 ppm). Control tests consisted of reaction flasks containing ^{14}C tagged D-Glucose to demonstrate microbial activity of the culture toward a known biodegradable compound. In another control sample ^{14}C MC-680 was suspended in distilled water (with addition of $HgCl_2$) eliminating the presence of microorganisms.

$^{14}CO_2$ liberation from universally radiocarbon labeled MC-680 was evident in all test samples throughout the study period reported. Degradation, however, is considered slow. A graphic illustration (Figure 2) demonstrates the daily rate of $^{14}CO_2$ respiration expressed as percent of theoretical substrate activity.



0 3 0 8

During the past 4 weeks of incubation, $^{14}CO_2$ evolution appears to stabilize at a low rate ranging from 0.002 to 0.007 percent (T-I and T-II). The third group (lowest concentration - 1.0 ppm) is indicating similar tendencies, but percent recovery of ^{14}C-activity is slightly higher than in 1.0 and 0.01 percent MC-680.

Tables III through V present the radiometric results of tests T-I, T-II and T-III for each sampling period. Table VI presents the results of all control samples.

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

Report prepared by: Irene A. Dressler

Irene A. Dressler, M. S.
Group Leader
Metabolic Studies

Report approved by: M. L. Keplinger

M. L. Keplinger, Ph. D.
Manager, Toxicology

lam:bp

[redacted]

0 3 0 4

III. Experimental Procedures

A. Preparation of Medium

The test medium consisted of a mixture of acclimated microbial inoculum, fresh raw sewage (settled) and supernatant of a fresh garden soil slurry.

Acclimation of the microorganisms was carried out in a minimum salts-vitamin medium supplemented with 25 mg/l each of yeast extract and vitamin-free casamino acid. During the acclimation period nonlabeled MC-680 was added in increments. On Day 1 and Day 7, 10 mg and 100 mg of the material was added, respectively. The contents were mixed well and aerated every other day, and held at 20° C in the dark. At various days during acclimation, test media were prepared using the acclimation culture to test the activity of th culture. After 18 days (9/9/75) the initial test series (1.0 and 0.01%) were set up.

At the start of the experiment (Day 0), fifty ml of supernatant of the acclimated microbial culture and 10 ml of settled fresh sewage were combined and diluted to 500 ml with the minimum salt and vitamin solution. Reagent water according to ASTM specifications was used for this preparation. Hydrogen ion concentration of acclimation culture and final test media were measured and revealed for both a pH of 7.0 at the start of the study.

B. Reaction Flask Contents

Erlenmeyer flasks (125 ml) were employed for all tests. The pre-weighed test material was placed first into the flasks, followed by addition of 30 ml of medium. In the case of the 1 ppm test solutions, the work

[redacted] This document contains confidential information which is the property of [redacted] Chemical Corporation. It must be accounted for and returned. [redacted]

PAGE 0180

MC-680 (^{14}C-labeled) was dissolved in ethylacetate. A volume of this solution containing the equivalent of 30 micrograms was pipetted into the reaction flask. The solvent was evaporated prior to addition of medium. To improve dispersion of the test material, 2 drops of a surfactant (TWEEN-80) were added to each of the test flasks.

Evolved $^{14}CO_2$ was continuously absorbed in an alkali solution. A small plastic cup was suspended over the medium in the center of the Erlmeyer flask; the cup contained 1.0 ml of 0.5 N KOH. A piece of pleated filter paper was placed into the alkali solution in such a way that half of the piece was projecting into the open space above (see Figure 1).

On September 9, 1975, two test groups (T-I: 0.01% and T-II: 1.0%) were started with four flasks each. The test material was weighed directly into the reaction flasks prior to adding 30 ml of the media. Table I presents the quantities of labeled and non-labeled MC-680 used in each test flask. Control flasks receiving the identical acclimated microorganism culture and ^{14}C-tagged D-glucose were also started. A third test group (T-III) containing ^{14}C-tagged MC-680 in the media at a concentration of 1 ppm (parts per million) was started on October 7, 1975. The test medium was prepared fresh for this series in the same manner as previously described. The acclimated inoculum was of the same origin as the one used in T-I and T-II. Duplicate positive control samples containing ^{14}C-glucose were also initiated on October 7 using a culture media identical to that prepared for test group T-III [redacted]

PAGE 018

A control flask receiving water and $HgCl_2$ (50 mg/l) instead of the microbial media, but containing ^{14}C-tagged MC-680 was included at this time. Table II presents the total radioactivity contained in each of the control flasks at the beginning of the experiment.

C. Operational Routines and Sampling Procedures

The reaction flasks were incubated in Dubnoff Shakers and held under continuous shaking. The rate of shaking was approximately 85 cycles per minute. The temperature of the reaction vessels varied with the ambient room conditions between 19 and 23° C. Except for brief periods of sampling, the flasks were kept in the dark throughout the study to prevent algae growth. Periodically, each flask was purged with a 70:30 O_2/N_2 mixture; this was done usually at sampling time and not less than once a week.

The KOH solution from the center cup was transferred quantitatively with several small rinses to a scintillation counting vial. The filter paper was added to the same vial and the contents were radioassayed in Instagel.

Counting was conducted in the Mark II counter (Nuclear Chicago). Efficiency corrections were made using the channels ratio method. Samples were dark adapted for at least 24 hours prior to radio assay and were routinely counted for 10 minutes.

During the early phase of incubation, the liberated $^{14}CO_2$ was monitored at short intervals. During the last 4 weeks samples were obtained once a week.

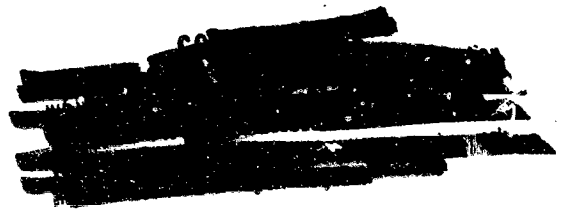
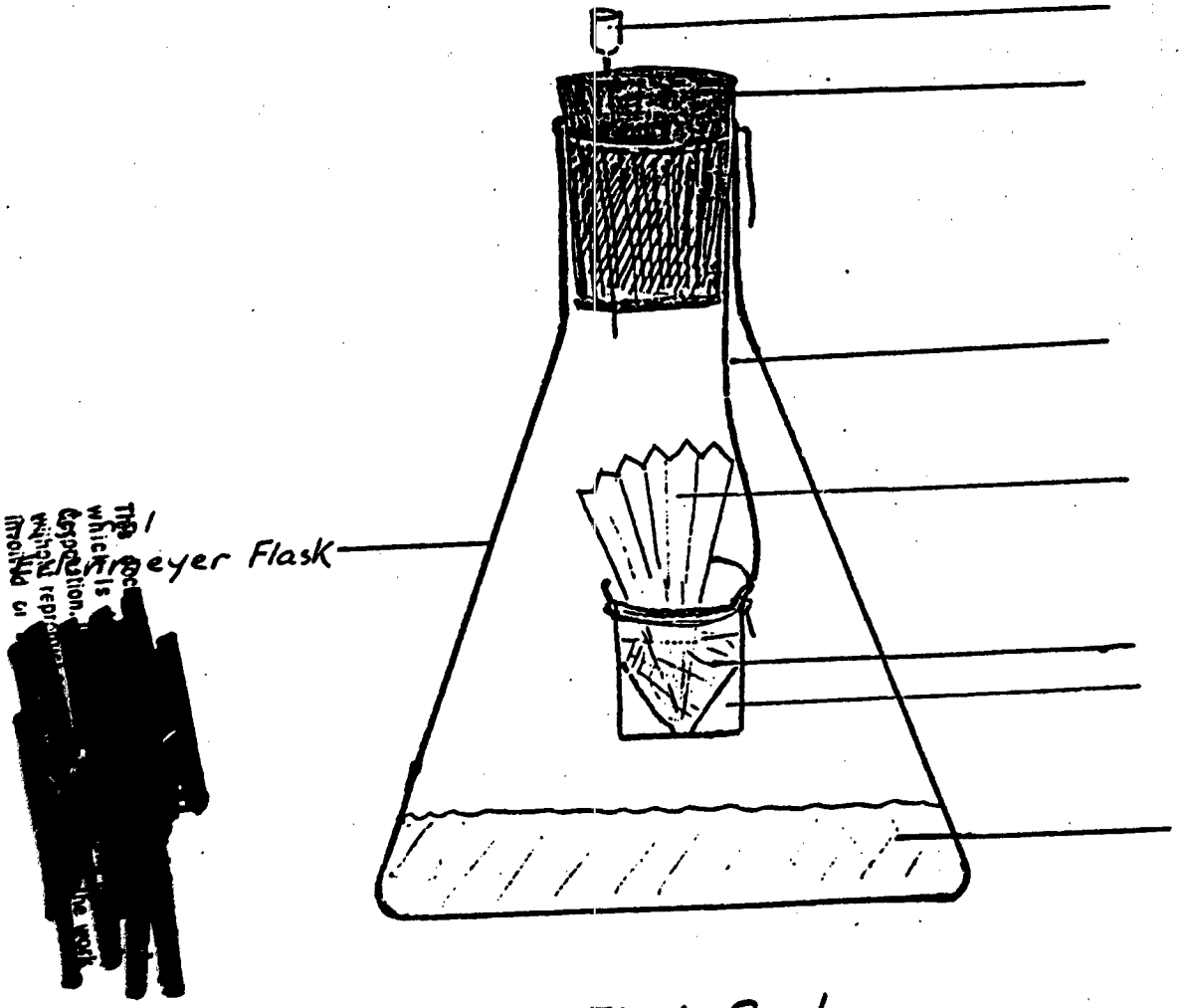


FIGURE 1



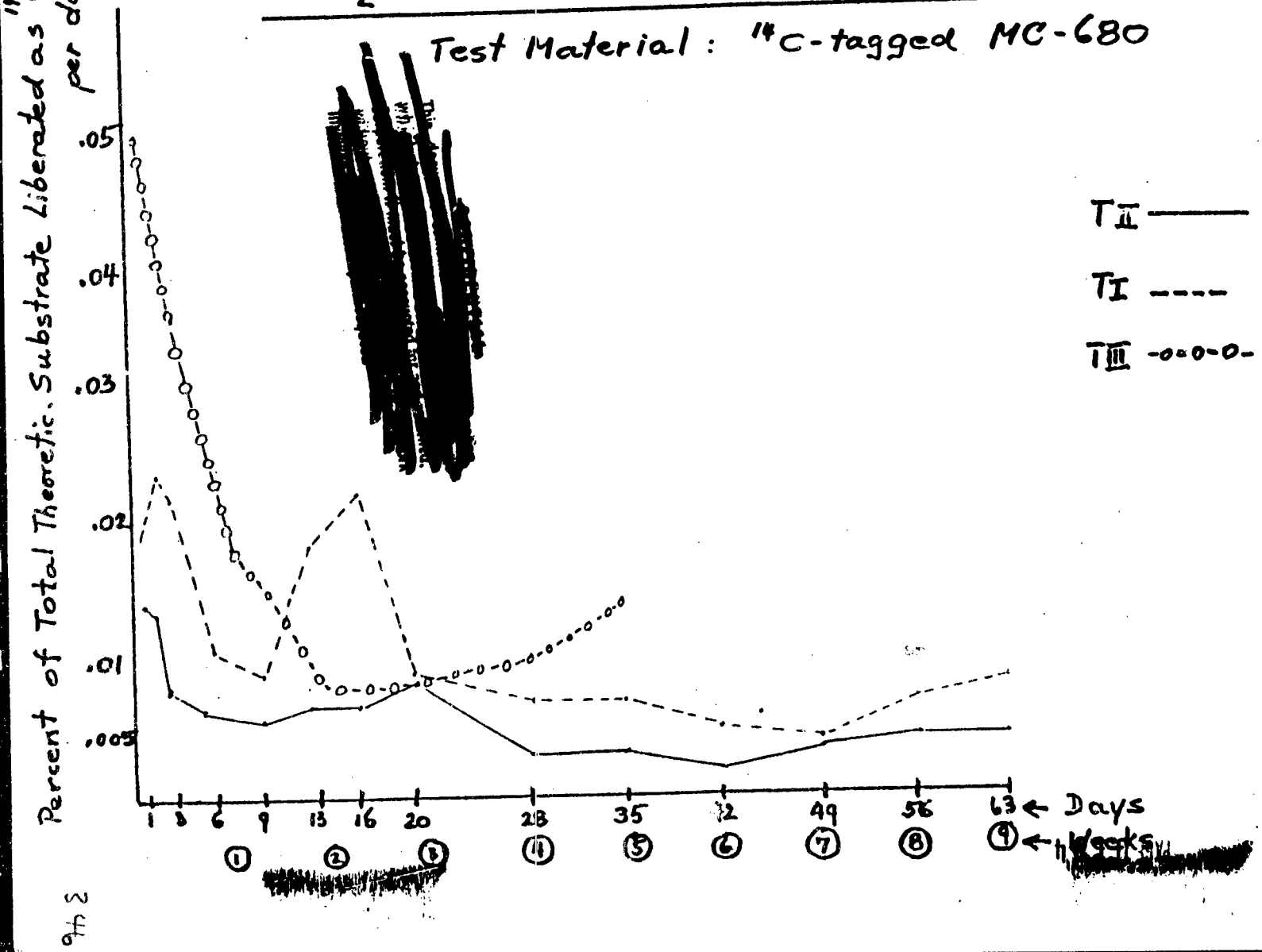
Shake Flask System

MF.# 0891

FIGURE 2

$^{14}CO_2$ - Evolution as a Function of Time.

Test Material: ^{14}C-tagged MC-680



Industrial BIO-TEST Laboratories, Inc.

TABLE I

TEST MATERIAL: MC-680

Bio-degradation Study with ^{14}C-tagged MC-680 - Status Report

Outline of Experiment

Test Samples

Concentration (percent)	Identification	Date Started	Replicate Number (Flasks)	MC-680 Added to Medium (30 ml) nonlabeled (mg)	^{14}C-tagged mg	Total Quantity (mg)	Total Radioactivity* net dpm x 10^6
1.0	T-II	9-9	1	289.42**	10.58**	300.00	798.58
			2	290.10	9.90	300.00	747.25
			3	289.89	10.11	300.00	763.10
			4	289.68	10.32	300.00	778.95
1.0×10^{-2}	T-I	9-9	1	0	2.91**	2.91	219.65
			2	0	3.27	3.27	246.82
			3	0	3.41	3.41	257.39
			4	0	3.41	3.41	257.39
		10-7	5	0	2.75	2.75	207.57
1.0×10^{-4}	T-III	10-7	1	0	31.46 (µg)	0.031	2.374
			2	0	31.46	0.031	2.374
			3	0	31.46	0.031	2.374
			4	0	31.46	0.031	2.374

* Specific activity of ^{14}C-tagged MC-680 equal 34 µc/mg

** Test material was weighed directly into flasks.

[redacted]

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[redacted]

Industrial BIO-TEST Laboratories Inc.

TABLE II

TEST MATERIAL: MC-680

Bio-degradation Study with ^{14}C-tagged MC-680 - Status Report

Outline of Experiment - continued

Control Samples

^{14}C-tagged Material Added	Date Started	Sample Identification	Total Radioactivity net dpm x 10^6	Media (30 ml)
D-Glucose	9-9	Gl - 1	12.117	Acclimated microorganisms
		Gl - 2	12.176	
D-Glucose	10-7	Gl - 5	13.728	Acclimated microorganisms
		Gl - 6	12.762	
MC-680	10-7	C-H_2O	2.374	H_2O, dist. + $HgCl_2$

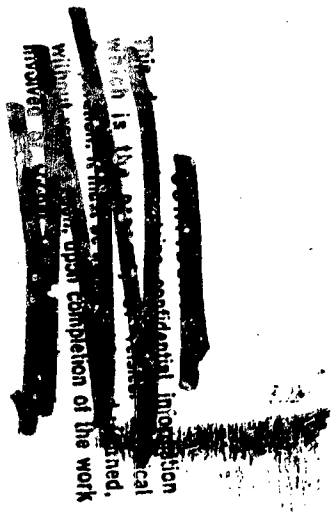

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TABLE III a

TEST MATERIAL: MC-680

Bio-degradation Study with ^{14}C-tagged MC-680 - Status Report

^{14}C-Activity Respired as $^{14}CO_2$ - Test Group T-I (0.01 percent)

Test Day Number	Average ^{14}C-Activity per Sampling Period net dpm*	Range net dpm	Daily Rate of $^{14}CO_2$ Liberation net dpm	Daily Rate of $^{14}CO_2$ Liberation Percent of Total Theoretical Substrate ^{14}C-Activity
1	47,759	37,114 - 52,369	47,759	0.019
2	57,769	37,553 - 102,859	57,769	0.023
3	52,605	39,372 - 71,755	52,605	0.022
6	78,793	62,506 - 92,927	26,264	0.011
9	67,790	61,767 - 73,126	22,597	0.009
13	170,143	102,380 - 232,422	42,536	0.018
16	161,195	78,914 - 261,006	53,732	0.022
20	86,330	56,946 - 134,133	21,583	0.009
28	133,222	66,423 - 228,427	16,653	0.007
35	117,152	82,728 - 187,110	16,736	0.007
42	88,482	67,042 - 117,250	12,640	0.005
49	73,720	48,555 - 107,073	10,531	0.004
Total	1,134,960 = 0.463 percent of initial radioactivity			

* Values represent mean of 4 reaction flasks.

[redacted]

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TABLE III b

TEST MATERIAL: MC-680

Biodegradation Study with ^{14}C-Tagged MC-680 - Status Report

^{14}C-Activity respired as $^{14}CO_2$ - Test Group T-I (0.01 percent)

Sample Replicate No. 5 (started: 10-7-1975)

Test Day Number	^{14}C-Activity per Sampling Period net dpm	Daily Rate of $^{14}CO_2$ Liberation net dpm	Daily Rate of $^{14}CO_2$ Liberation Percent of Total Theoretical Substrate ^{14}C-Activity
1	31,383	31,383	0.015
3	33,296	16,648	0.008
7	100,559	25,140	0.012
14	133,652	19,093	0.009
21	123,689	17,670	0.009
Total:	422,579 = 0.204 percent of initial radioactivity.		

Industrial BIO-TEST Laboratories, Inc.

PAGE 0188

WARF INSTITUTE, INC.
MADISON, WISCONSIN

8EHQ-0678-0154(N)

Reports are submitted to clients on a confidential basis. No reference to the work, the results or to the Institute in any form of advertising, news release or other public announcement may be made without written authorization from the Institute.

REPORT

Sample: LA-680 WARF No. 2081295

Submitted by: Richard Nametz
Michigan Chemical Corp
Chicago, Illinois

Date Received: 8/11/72

Testing requested:

Acute oral LD 50
Acute dermal LD 50
Skin irritation
Eye irritation

Sample description:

Experimental Flame Retardant

Conclusion:

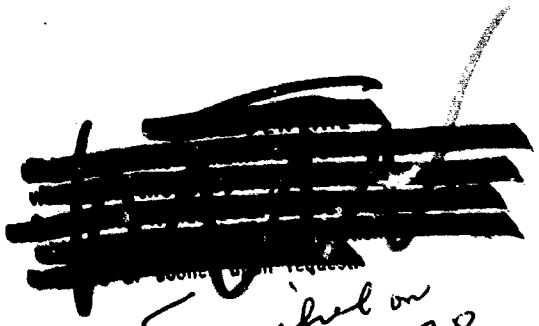
Under the conditions specified the product has an estimated oral LD 50 in excess of 10 grams per kilogram of body weight, a primary skin irritation index of 0, and eye irritation scores of 0, 0 and 0 at 24, 48 and 72 hours respectively.

Within the meaning of the F.H.S.A. the product is not toxic orally, not irritating to the eye and not irritating to the skin. The acute dermal LD 50 is in excess of 2 grams per kilogram of body weight and is considered not toxic dermally.

Signed John J. Birdsall

By and for WARF Institute Inc.

Date: September 11, 1972



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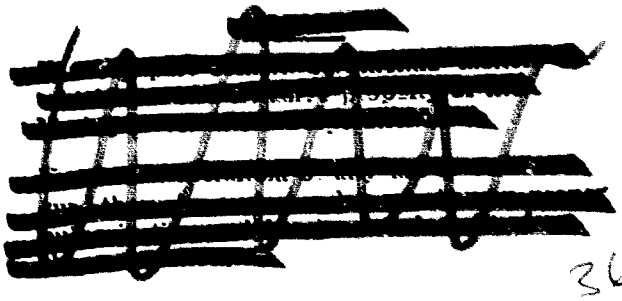

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FORM 36-4

WARF INSTITUTE, INC.
MADISON, WISCONSIN

Sample: LA-680 WARF No. 2081295

Acute Oral Toxicity:

Method: Adult albino male rats of the Sprague-Dawley strain, weighing 150-250 grams were fasted for 24 hours, then given a single calculated dose and placed in screen bottom cages with free access to water and laboratory chow for a two week observation period.

Administration:

Method: stomach tube
Concentration of test material and diluent of test material: 333 mg/ml in corn oil
Sample preparation:

Results:

Dosage level [1] (gm/kg)	Mortality Number [2]	Day [3]
5	0/6	
10	0/6	

[1] Of test material
[2] Number dead/number dosed
[3] Period during which deaths were observed.

Estimated oral LD 50: in excess of 10 gm/kg

Oral Toxicity ratings

Oral LD 50 per kg body weight	General classification [1]	Federal Hazardous Substances Labeling Act
1 mg or less	Extremely toxic	Highly toxic
1 to 50 mg	Highly toxic	Highly toxic
50 to 500 mg	Moderately toxic	Toxic
0.5 to 5 gm	Slightly toxic	Toxic [2]
5 to 15 gm	Practically non-toxic	Non-toxic
15 gm or more	Relatively harmless	Non-toxic

[1] Gleason, Gosselin, and Hodge, "Clinical Toxicology of Commercial Products", 1957
[2] Under special conditions may not require toxic label

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WARF INSTITUTE, INC.
MADISON, WISCONSIN

Sample: LA-680 WARF No. 2081295

Primary Skin Irritation:

Method: Albino rabbits were used for this work. They were housed in individual screen-bottom cages and fed water and rabbit chow ad libitum. The hair was clipped from the back and flanks of the animal. The test material was applied to two areas on each of six rabbits, 1 abraded area, and 1 intact area, in the amount of 0.5 ml per area in the case of liquids or 0.5 gm per area in the case of solids. The treated areas were covered with gauze patch and tape to maintain the test material in contact with the skin and decrease the rate of evaporation. The animals were fitted with collars for a 24 hour period at which time the coverings were removed, and the degree of erythema edema were recorded according to the scale below. A second reading was taken at 72 hours. The average of the 24 and 72 hour readings was used to determine the primary irritation score for the sample.

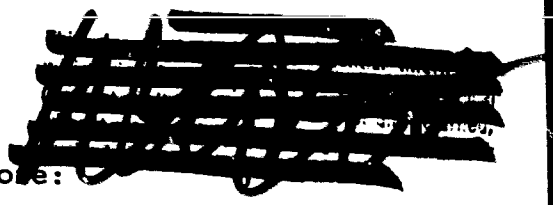
Application:

Concentration of test material: as submitted

Diluent or solvent: patches moistened with water

Results:

Animal No.	24 hours		72 hours		
	Abraded	Unabraded	Abraded	Unabraded	Average
1					
2					
3	No Irritation				
4	All readings negative				
5					
6					



Primary skin irritation score:

Scale for Evaluation of Skin Reaction

Erythema and Eschar Formation	Score	Edema Formation	Score
Slight erythema	1	Slight edema (barely perceptible)	1
Defined erythema	2	Defined edema (edges definite rising)	2
Moderate to severe erythema	3	Moderate edema (area raised 1 mm)	3
Severe erythema to slight eschar formation	4	Severe edema (raised more than 1 mm)	4

Score equals sum of erythema and edema readings.
Skin irritation index equals average of 24 and 72 hour scores

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Sample: LA 680

Eye Irritation

Method: Adult albino rabbits of the New Zealand White variety were placed in a collar such that the animals could not rub their eyes. One-tenth of a milliliter (0.1 gm for solids) of test substance was instilled in one eye, the other untreated eye served as a control. A series of six albino rabbits was used for each substance. The reaction to the test material was read according to the scale of scoring for damag to the cornea, iris and the bulbar and palpebral conjuctivae at 24, 48 and 72 hours after eye instillation. Any residue of the test material and accumulated discharge are flushed from the eye each time they are scored.

Administration:

Concentration of test sample used: as submitted

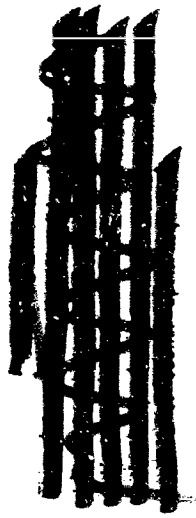
Diluent or solvent: none

Special washing: none

MRE 0205

Results:

	Rabbit No	Cornea: Opacity	Cornea: Area	Cornea: Iris	Conjunctivae: Redness	Conjunctivae: Chemosis	Conjunctivae: Discharge
24 hours	1						
	2						
	3	NO IRRITATION					
	4	ALL READINGS NEGATIVE					
	5						
	6						
		24 hour eye irritation score: 0					
48 hours	1						
	2						
	3						
	4	NO IRRITATION					
	5	ALL READINGS NEGATIVE					
	6						
		48 hour eye irritation score: 0					
72 hours	1						
	2	NO IRRITATION					
	3	ALL READINGS NEGATIVE					
	4						
	5						
	6						
		72 hour eye irritation score: 0					



FORM 28-A

Sample: LA 680 WARF No. 2081295

Acute Dermal:

Method: Adult, male rabbits were employed. The animals were housed in individual screen-bottom cages and supplied with water and a commercial laboratory chow ad libitum. The test materials were supplied by injection under a sleeve of rubber snugly fastened about the clipped trunk of the test animal. The animals were immobilized for a 24 hour period immediately following treatment. At the end of the exposure period the sleeves were removed and the animals returned to cages for a two week observation period during which evidences of toxicity were noted and mortality data tabulated.

Results:

Animal Number	Dose gm/kg	Body weight (gms) Initial	1 week	2 weeks
1	2	2491	2538	2729
2	2	1914	2116	2286

The acute dermal LD 50 is in excess of 2 gm/kg

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FORM 28-4

0 3 3 b

WARF INSTITUTE, INC.

September 11, 1972

Dr. Richard Nametz
Michigan Chemical Coporation
351 E. Ohio Street
Chicago, Illinois 60611

PAGE 0201

Dear Dr. Nametz:

Enclosed are the results of the tests on the sample of compound LA 680.

We were unable to conduct the higher levels on the acute dermal test due to a shortage of sample. We require approximately 150 grams of material to do three levels on the oral and dermal tests. The enclosed invoice reflects the fewer animals.

If you have any questions concerning the results, please call me at 608 249-7400.

Very truly yours,

Leonard Rapp
Biological Department

LR:sd
Enclosure

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0 4 3 7

88-7800184

8EHQ-0678-0184

RECEIVED JUN 14 1978

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

MF 0209

REPORT TO

MICHIGAN CHEMICAL CORPORATION

BIODEGRADABILITY STUDY WITH ^{14}C-TAGGED MC-680

JUNE 11, 1976

JBT NO. 632-07189

370

0338

Industrial **BIO-TEST** *Laboratories, Inc.*
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

June 11, 1976

Dr. F. A. Daniher, Manager
Research & Development
Michigan Chemical Corporation
1975 Green Road
Ann Arbor, Michigan 48105

PAGE 0210

Dear Dr. Daniher:

[illegible] 189 - [illegible] dability study with
[illegible] MC-680

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC:trm

0 3 3 4

Industrial BIO-TEST Laboratories, Inc.

REPORT TO

MICHIGAN CHEMICAL CORPORATION

BIODEGRADABILITY STUDY WITH
^{14}C-TAGGED MC-680

JUNE 11, 1976

IBT NO. 632-07189

MCC 0211

I. Introduction

At the request of Michigan Chemical Corporation, a biodegradation study was conducted to determine the extent of degradation of the flame-retardant material MC-680.

A sample of ^{14}C-labeled MC-680 with a specific activity of 34 microcuries (μc) per mg was prepared by Amersham/Searle Corporation. The test material was tested at 3 different concentrations using a simple shake-flask system. The rate of degradation was monitored by measuring the amount of $^{14}CO_2$ liberated.

This report describes the test procedures and presents the results obtained during 30 weeks of testing.

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II. Summary

The purpose of this study was to obtain information on the rate of biodegradability of the fire-retardant MC-680 in an acclimated heterogeneous microbial system.

Uniformly ^{14}C-tagged MC-680 was exposed to microorganisms derived from fresh settled sewage and garden soil in a shake flask system. The extent of ultimate degradation was monitored by measuring the amount of $^{14}CO_2$ liberated due to degradation of the labeled test material by the microorganisms present. Each reaction vessel (Erlenmeyer flask) was equipped with a small center cup containing the KOH solution for absorption of the respired $^{14}CO_2$. The experiment was maintained for a period of 30 weeks for test groups I and II, and 26 weeks for test group III, not including previous microbial acclimation.

During an 18-day acclimation period microorganisms derived from sewage and garden soil were exposed to nonlabeled MC-680. The adapted bacterial seed organisms were then used to prepare the test media. Three different concentrations of ^{14}C-labeled test material in microbial media were prepared (1.0 and 0.01 percent, and 1.0 ppm). Control tests consisted of reaction flasks containing ^{14}C-tagged D-Glucose to demonstrate microbial activity of the culture toward a known biodegradable compound. In another control sample ^{14}C-MC-680 was suspended in distilled water (with addition of $HgCl_2$) eliminating the presence of viable microorganisms.

MSC 021

ıcubation of tests T-I and T-II (0.01 and 1.0 percent) was terminated after 211 days or 30 weeks; from test group T-III (1 ppm) a final sample was obtained at 183 days (26 weeks).

Evolution of $^{14}CO_2$ from degradation of uniformly labeled ^{14}C-MC-680 was evident in all test samples. The rate of degradation, however, is considered low. Following an initially accelerated $^{14}CO_2$ liberation, $^{14}CO_2$ absorption decreased to about 0.001 to 0.008 percent of the total ^{14}C-activity in the system in groups T-I and T-II. The test group containing 1.0 ppm of ^{14}C-MC-680 in the medium revealed slightly higher recovery values (range: 0.003-0.014 percent).

AGE 0213

Total ^{14}C-activity, liberated as $^{14}CO_2$, accumulated to 2.67×10^6 dpm in group T-I (0.01%) and to 4.64×10^6 dpm in group T-II (1.0%), representing tot recoveries of 1.11 and 0.53 percent of the initially applied ^{14}C-activity (labeled MC-680). In the third test group (T-III) containing 1 part of ^{14}C-MC-680 per million parts of media, the total ^{14}C-activity recovered during 183 days of incubatio amounted to 1.41 percent of total ^{14}C applied. These results indicate that the rate of degradation was slightly favored in the lower concentration levels. Inhibition of growth rate of the microbial population in the presence of MC-680 at the 1.0 percent level may have been responsible for a reduced $^{14}CO_2$ evolution.

0 3 4 2

Table I presents a summary of the radiometric assays of tests T-I, T-II and T-III for each sample period; in addition, Figure 1 illustrates these data. Table II presents a summary of all control samples.

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

Report prepared by: Irene Dressler

Irene A. Dressler, M.S.
Group Leader
Metabolic Studies

Report approved by: Florence K. Kinoshita

Florence K. Kinoshita, Ph. D.
Technical Manager, Toxicology

M. L. Keplinger

M. L. Keplinger, Ph. D.
Manager, Toxicology

trm

MF 0214

0 3 4 3

TABLE I

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

Summary of Respired $^{14}CO_2$ Activity

Test Day Number	Average Daily Rate of $^{14}CO_2$ Evolution Expressed As Percent of Total Theoretical Substrate ^{14}C-Activity Test Material Concentrations: 1.0 percent (T-II)	0.01 percent (T-I)	1 ppm (T-III)
1	0.014	0.019	0.050
2	0.013	0.024	N.A.
3	0.008	0.022	0.032
6	0.007	0.011	N.A.
7	N.A.	N.A.	0.016
9	0.006	0.009	N.A.
13	0.007	0.018	N.A.
14	N.A.	N.A.	0.008
16	0.007	0.022	N.A.
20	0.008	0.009	N.A.
21	N.A.	N.A.	0.008
28	0.003	0.007	0.010
35	0.003	0.007	0.014
42	0.002	0.005	0.012
49	0.003	0.004	0.010
56	0.003	0.007	N.A.
63	0.003	0.008	N.A.
70	0.002	0.004	0.005
77	0.002	0.004	N.A.
91	N.A.	N.A.	0.003
98	0.001	0.004	N.A.
119	0.001	0.006	0.008
147	0.003	0.003	N.A.
155	N.A.	N.A.	0.006
161	0.002	0.005	N.A.
183	0.002	0.003	0.006
211	0.001	0.002	N.A.

N.A. = Not analyzed.

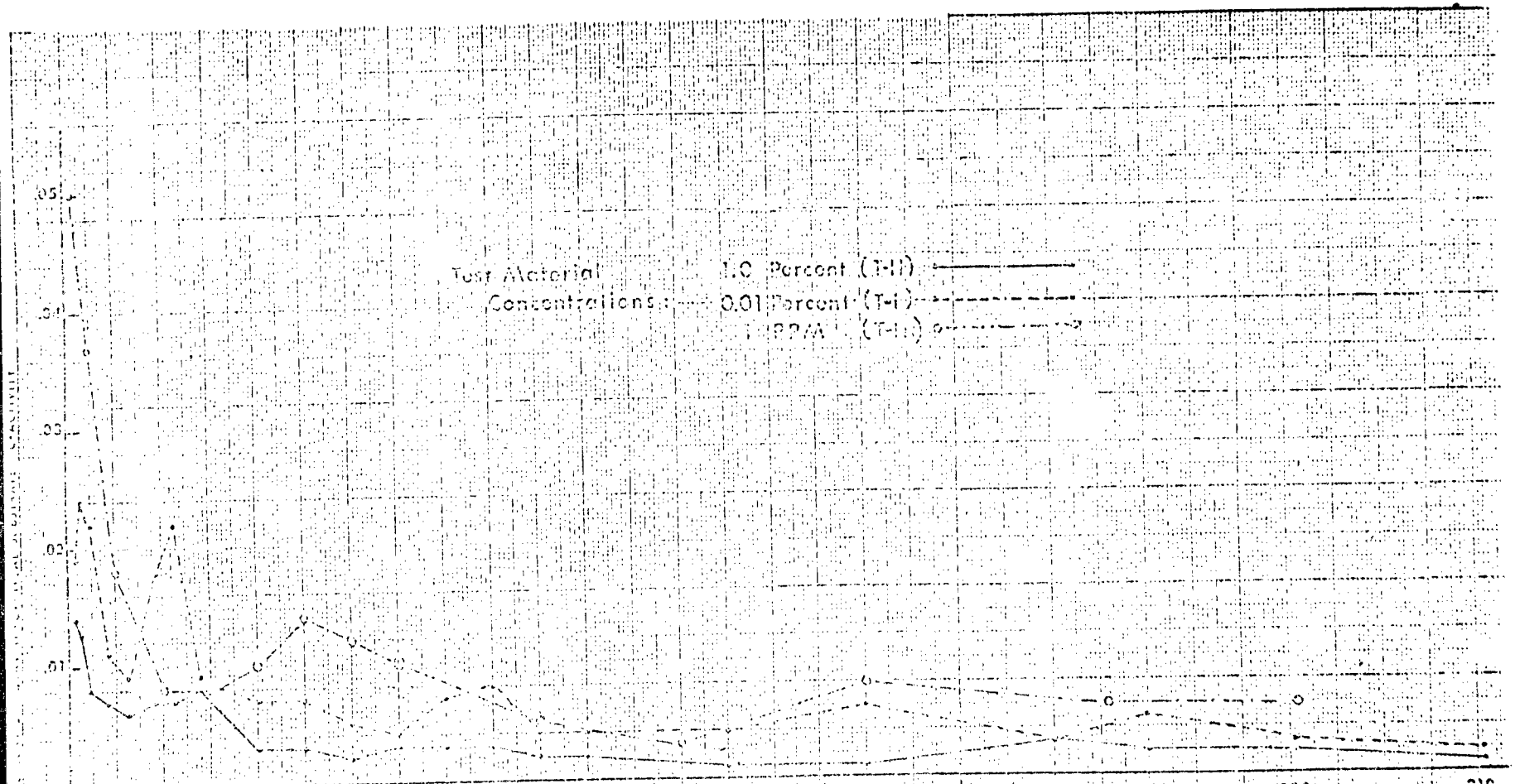

FIGURE 1. AVERAGE DAILY RATE OF $^{14}CO_2$ EVOLUTION. TEST MATERIAL: MC-630

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TABLE II

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

Summary of Respired $^{14}CO_2$ Activity

Test Day Number	Average Daily Rate of $^{14}CO_2$ Evolution Expressed As Percent of Total Theoretical Substrate ^{14}C-Activity Control Samples: Glucose 1 & 2	Glucose 3 & 4	H_2O-$HgCl_2$
1	27.29	20.86	0.000
2	4.81	-	-
3	6.18	7.80	0.002
6	5.78	-	-
7	-	7.28	0.000
9	5.53	-	-
13	4.94	-	-
14	-	2.98	0.000
16	3.35	-	-
20	2.54	-	-
21	-	1.03	0.001
28	1.49	0.59	0
35	5.49	0.64	<0.001
42	1.96	0.66	0.000
49	0.84	0.41	0.008
56	0.55	0	0
63	0.49	-	-
70	0.44	0.35	<0.001
77	0.55	-	-
91	-	0.23	0.001
98	1.01	-	-
119	0.16	0.13	0.001
147	0.12	-	-
155	-	0.14	0.002
161	-	-	-
183	0.09	0.13	0.001
211	0.07	-	-

III. Experimental Procedures

A. Determination of Toxic Concentration Levels

A screening test was initially conducted in which non-labeled MC-680 was used to examine the effects of the chemical on the biological oxidation rate of microorganisms. Oxygen utilization was determined manometrically at various concentration levels using the conventional Warburg Constant Volume Respirometer method. The biological seed culture was prepared from fresh sewage and top soil. The concentrations of MC-680 in the media ranged from 0.1 ppm to 10 percent.

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The results of the manometric measurements indicated concentration-dependent toxicity at the 10 percent level. Amongst the remaining test levels, ranging from 0.1 ppm to 1 percent, oxygen uptake during the first 72 hours was similar to that observed in the control flask (microbial media without test material). A slight decrease of oxygen utilization was observed after 72 hours at the 1 percent test level indicating possible growth inhibition of the microbial population effected by the presence of the test material.

B. Microbial Acclimation

Acclimation of the microorganisms to the test compound was carried out in a minimum salts-vitamin medium supplemented with 25 mg/l each of yeast extract and vitamin-free casamino acid. During the acclimation period nonlabeled MC-680 was added in increments. On Day 1 and Day 7, 10 mg and 100 mg of the material were added, respectively. The contents were mixed well and aerated every other day, and held at 20°C in the dark. At

0 3 4 7

various intervals during acclimation, test media samples were prepared using the acclimation culture and tested for microbial activity. Radiocarbon-labeled glucose served as a readily biodegradable compound.

Following 18 days of acclimation, the first 2 tests were initiated with 0.01 and 1.0% of MC-680 (T-I and T-II, respectively). A third test group containing 1 ppm of ^{14}C MC-680 per microbial medium (T-III) was started 46 days after initiation of the acclimation culture. The original inoculum (acclimation media) was used in each test.

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C. Reaction Flask Contents

The test medium was prepared as follows: 50 ml of supernatant of acclimated microbial culture and 10 ml of settled fresh sewage were combined and diluted to 500 ml with a minimum salt and vitamin solution. Reagent water according to ASTM specifications was used for this preparation. Hydrogen ion concentration of the final test media was adjusted to a pH value of 7.1 at the start of the study.

Thirty ml of the above solution was added to 125 ml-Erlenmeyer flasks containing the test material. Flask replication consisted of 4 for each concentration level. The test chemical was weighed directly into the flask or transferred quantitatively dissolved in ethylacetate (1.0 ppm). The solvent was completely evaporated prior to addition of medium. Table III presents the actual quantities applied to each reaction flask. Two drops of a surfactant (Tween-80) were added to aid dispersion of the suspended material in the 1 percent concentration tests.

TABLE III

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

Outline of Experiment

Test Samples

Concentration (percent)	Identification	Date Started	Replicate Number (Flasks)	MC-680 Added to Medium (30 ml) Nonlabeled (mg)	^{14}C-tagged (mg)	Total Quantity (mg)	Total Radioactivity* net dpm x 10^6
1.0	T-II	9-9	1	289.42**	10.58**	300.00	798.58
			2	290.10	9.90	300.00	747.25
			3	289.89	10.11	300.00	763.10
			4	289.68	10.32	300.00	778.95
$.0 \times 10^{-2}$	T-I	9-9	1	0	2.91**	2.91	219.65
			2	0	3.27	3.27	246.82
			3	0	3.41	3.41	257.39
			4	0	3.41	3.41	257.39
		10-7	5	0	2.75	2.75	207.57
$.0 \times 10^{-4}$	T-III	10-7	1	0	31.46 (µg)	0.031	2.374
			2	0	31.46	0.031	2.374
			3	0	31.46	0.031	2.374
			4	0	31.46	0.031	2.374

Specific activity of ^{14}C-MC-680 equals 34 µc/mg.
Test material was weighed directly into flasks.

Duplicate control tests containing ^{14}C-D-glucose in place of the test compound MC-680 were initiated at each of the 2 starting dates. These flasks received microbial media and inoculum identical to that of the respective test sets and were included to demonstrate microbial activity of the culture towards a known degradable material.

A control flask receiving water and $HgCl_2$ (50 mg/l) instead of the microbial media, but containing ^{14}C-MC-680 was also included. Table IV presents the total radioactivity contained in each of the control flasks at the beginning of the experiment.

Evolved $^{14}CO_2$ was continuously absorbed in an alkali solution. A small plastic cup was suspended over the medium in the center of the Erlenmeyer flask; the cup contained 1.0 ml of 0.5 N KOH. A piece of pleated filter paper was placed into the alkali solution in such a way that half of the piece was projecting into the open space above (see Figure 2).

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TABLE IV

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

Outline of Experiment - continued

Control Samples

^{14}C-tagged Material Added	Date Started	Sample Identification	Total Radioactivity net dpm x 10^6	Media (30 ml)
D-Glucose	9-9	Gl - 1	12.117	Acclimated microorganisms
		Gl - 2	12.176	
D- Glucose	10-7	Gl - 5	13.728	Acclimated mocroorganisms
		Gl - 6	12.762	
MC-680	10-7	C-H_2O	2.374	H_2O, dist. + $HgCl_2$

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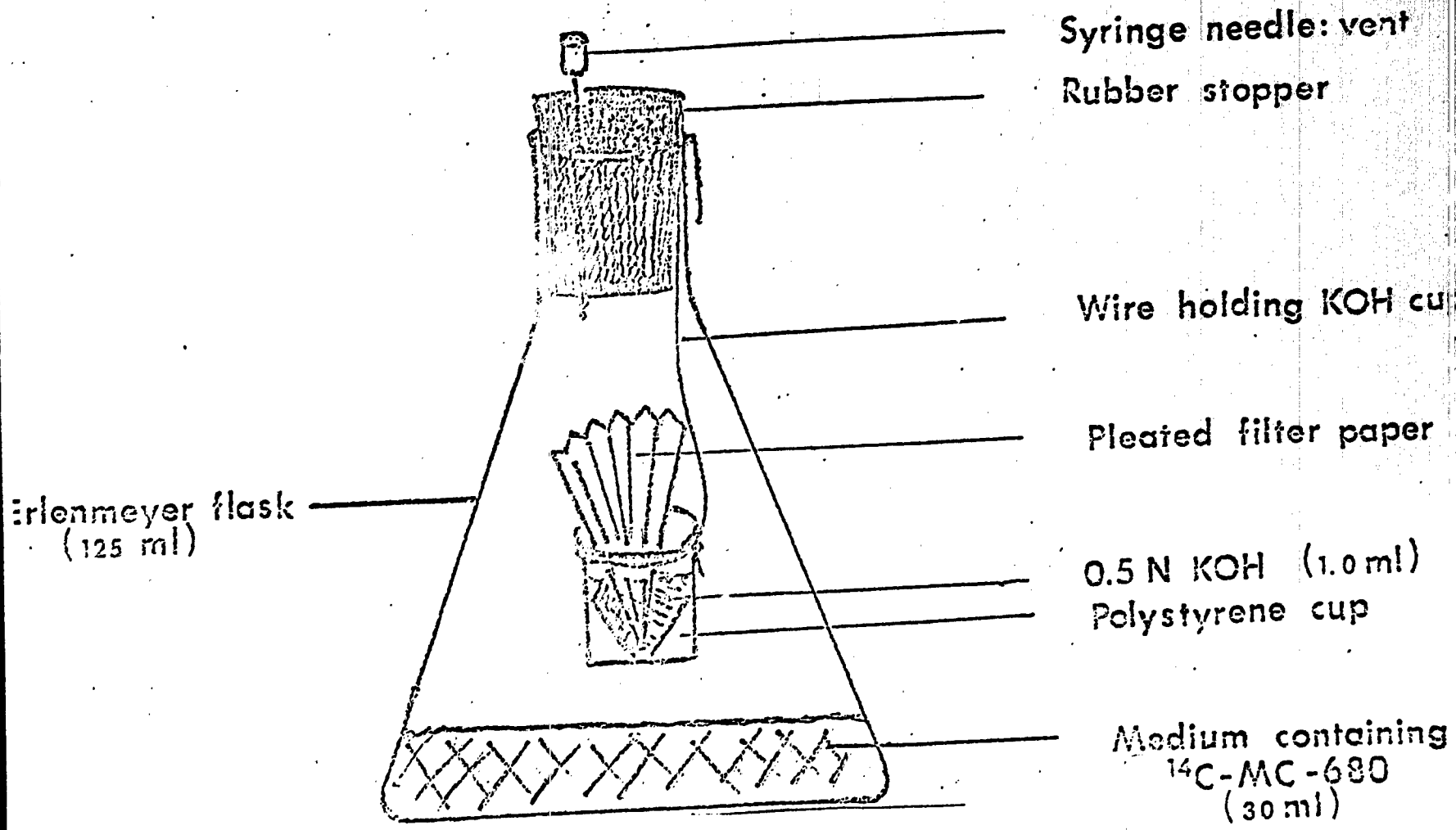

Figure 2. Shake-Flask System

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C. Operational Routines and Sampling Procedures

The reaction flasks were incubated in Dubnoff Shakers with continuous shaking. The rate of shaking was approximately 85 cycles per minute. The temperature of the reaction vessels varied with the ambient room conditions between 19 and 23°C. Except for brief periods of sampling, the flasks were kept in the dark throughout the study to prevent algae growth. Periodically, each flask was purged with a 70:30 O_2/N_2 mixture; this was done usually at sampling time and not less than once a week.

The KOH solution from the center cup was transferred quantitatively with several small rinses to a scintillation counting vial. The filter paper was added to the same vial and the contents were radioassayed in Instagel.

During the early phase of the experiment, liberation of $^{14}CO_2$ was monitored at shorter intervals; after 3 weeks of incubation, samples were obtained once a week. Total incubation time for tests T-I and T-II was 211 days (30 weeks); the T-III (1 ppm)-units were tested for a total of 183 days or 26 weeks.

D. Measurement of Radioactivity

A Searle Analytic Mark II liquid scintillation counter was employed for all radiometric determinations. Efficiency corrections were made using the channels ratio method[1]. Quenching curves were prepared using toluene-^{14}C standards (radioactivity: 2×10^5 dpm) quenched by additions of variable amounts of carbon tetrachloride[2].

[1] Bruno, G. A., and Christian, J. E., Anal. Chem. 35, 1024 (1961).
[2] ^{14}C-Quenched Standards, Amersham/Searle Corporation, Arlington Heights, Illinois.

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Counting efficiencies were in a range between 77 and 82 percent. The samples were routinely counted for 10 minutes and occasionally for longer periods (100 minutes). The samples were counted in low potassium glass vials and allowed to dark adapt in the cooled counting chamber (4°C) for at least 24 hours prior to radioassay.

E. Sensitivity of Detection

Detection of 5 counts above background could be made with extended counting time (100 minutes), this represents 7 disintegrations per minute (dpm) or 92.7 picograms of ^{14}C-MC-680. For any particular sample, the sensitivity in terms of concentration would depend upon the volume of sample employed.

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IV. Results

Tables V through VII present the data of the radiometric assays of liberated $^{14}CO_2$ in the flask. The results are computed as percent of theoretical $^{14}CO_2$ respiration from the total known substrate activity at each sampling interval.

Evolution of $^{14}CO_2$ arriving from universally radiocarbon-labeled MC-680 was evident in all tests throughout the study period. During the first two weeks of incubation, the rate of ultimate degradation was comparatively high in all test levels, with a high value of 0.05 percent theoretical CO_2 evolution on Day 1 in the 1 ppm concentration test. Following approximately 6 weeks of exposure, $^{14}CO_2$-liberation appeared to have stabilized to an average daily rate ranging from 0.003 to 0.010 percent in the 3 test groups. Total percent recovery of ^{14}C-activity absorbed as $^{14}CO_2$ was highest in the 1 ppm ^{14}C-MC-680 group; lowest recovery was observed in the 1.0 percent group.

Tables VIII and IX present the data of radioassays of the control flasks containing ^{14}C-tagged D-glucose, and ^{14}C-MC-680 without viable micro-organisms.

The positive ^{14}C-glucose control served to assure the viability and activity of the seed organisms used in the test flasks. Within 28 days of continuous incubation an average of approximately 71 percent of the initial radioactivity was completely degraded in flasks 1 and 2. Positive control flasks No. 5 and 6 were started 4 weeks later using the same acclimated

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0 3 5 5

bacterial population in combination with fresh sewage microorganisms. After 28 days, 65 percent of the original ^{14}C activity had been degraded to $^{14}CO_2$.

Only trace amounts of $^{14}CO_2$ were detected in flasks containing ^{14}C-MC-680 in the absence of microorganisms.

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TABLE V

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
1	1	219,650,000	29,877	37,114	0.017	
	2	246,820,000	41,555	51,557	0.021	
	3	257,390,000	42,262	52,369	0.020	
	4	257,390,000	40,296	49,995	0.019	0.019
2	1	219,612,886	36,034	44,874	0.020	
	2	246,768,443	82,699	102,859	0.042	
	3	257,337,631	30,305	37,553	0.015	
	4	257,340,005	36,860	45,789	0.018	0.024
3	1	219,568,012	59,700	71,755	0.033	
	2	246,665,584	42,994	51,800	0.021	
	3	257,300,078	32,679	39,372	0.015	
	4	257,294,216	39,419	47,493	0.018	0.022
6	1	219,496,257	56,168	71,279	0.032	
	2	246,613,784	67,847	88,458	0.036	
	3	257,260,706	48,505	62,506	0.024	
	4	257,246,723	71,554	92,927	0.036	0.011

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TABLE V continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net cpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity
9	1	219,424,978	49,661	61,767	0.028	
	2	246,525,326	58,793	73,126	0.030	
	3	257,198,200	50,943	63,520	0.025	
	4	257,153,796	58,560	72,745	0.028	0.009
13	1	219,363,211	186,170	232,422	0.106	
	2	246,452,200	169,441	211,010	0.086	
	3	257,134,680	81,904	102,380	0.040	
	4	257,081,051	107,941	134,758	0.052	0.018
16	1	219,130,789	63,368	78,914	0.036	
	2	246,241,190	208,283	261,006	0.106	
	3	257,032,300	106,560	132,702	0.052	
	4	256,946,293	138,071	172,158	0.067	0.022
20	1	219,051,875	45,557	56,946	0.026	
	2	245,930,184	57,281	71,423	0.029	
	3	256,899,598	66,422	82,820	0.032	
	4	256,774,135	107,709	134,133	0.052	0.009

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TABLE V continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
28	1	218,994,929	184,112	228,427	0.104	
	2	245,908,761	99,950	124,316	0.051	
	3	256,816,778	91,661	113,723	0.044	
	4	256,640,002	53,593	66,423	0.026	0.007
35	1	18,766,502	149,875	187,110	0.086	
	2	245,784,445	66,348	82,728	0.034	
	3	256,703,055	84,239	104,905	0.041	
	4	256,573,579	75,374	93,866	0.037	0.007
42	1	218,579,392	94,293	117,280	0.054	
	2	245,701,717	53,969	67,042	0.027	
	3	256,598,683	73,082	91,467	0.036	
	4	256,479,713	62,511	78,139	0.030	0.005
49	1	218,462,112	38,990	48,555	0.022	
	2	245,634,675	60,766	75,768	0.031	
	3	256,506,683	82,232	107,073	0.042	
	4	256,401,574	50,914	63,484	0.025	0.004

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TABLE V continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
56	1	218,413,557	62,900	78,137	0.036	
	2	245,558,907	97,039	120,545	0.049	
	3	256,399,610	129,484	160,850	0.063	
	4	256,338,090	80,044	99,310	0.039	
63	1	218,335,420	93,432	115,921	0.053	0.007
	2	245,438,362	139,810	173,247	0.071	
	3	256,238,760	115,825	144,240	0.056	
	4	256,238,780	108,175	134,546	0.052	
70	1	218,219,499	45,460	56,262	0.026	0.008
	2	245,265,115	69,058	85,574	0.035	
	3	256,094,520	69,184	85,624	0.033	
	4	256,104,234	60,319	74,652	0.029	
77	1	218,163,237	48,365	59,932	0.027	0.004
	2	245,179,541	46,752	57,933	0.024	
	3	256,008,896	81,794	101,734	0.040	
	4	256,029,582	63,759	78,910	0.031	
						0.004

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Industrial BIO-TEST Laboratories, Inc.

TABLE V continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
98	1	218,103,305	180,782	224,853	0.103	
	2	245,121,608	159,950	198,696	0.081	
	3	255,907,162	185,135	230,842	0.090	
	4	255,950,672	190,426	236,554	0.092	0.004
119	1	217,878,452	121,753	156,696	0.072	
	2	244,922,912	150,326	191,987	0.078	
	3	255,676,320	274,700	350,383	0.137	
	4	255,714,118	434,757	555,245	0.217	0.006
147	1			Contaminated Sample		
	2	244,730,925	168,869	214,573	0.088	
	3	255,325,937	(2,564 049)	(3,165,492)	(1.24)	
	4			Contaminated Sample		0.003
161	1	217,721,756	126,372	161,395	0.074	
	2	244,516,352	127,338	163,463	0.067	
	3	252,160,445	157,928	202,213	0.080	
	4	255,158,873	92,903	120,653	0.047	0.005

Industrial BIO-TEST Laboratories, Inc.

TABLE V continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group I (0.01 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
183	1	217,560,361	87,300	111,780	0.051	
	2	244,352,889	150,552	192,276	0.079	
	3	251,958,232	200,351	256,203	0.102	
	4	255,038,220	104,992	134,605	0.053	0.003
211	1	217,448,581	54,837	69,856	0.032	
	2	244,160,613	163,884	208,504	0.085	
	3	251,702,029	134,539	171,606	0.068	
	4	254,903,615	72,605	92,964	0.036	0.002

a Net cpm is defined as sample count rate per minute (cpm) minus background count rate (50 cpm).
b Net dpm is defined as net cpm corrected for counting efficiency to 100 percent (dpm).

TABLE VI

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
1	1	798,580,000	75,499	93,555	0.012	
	2	747,250,000	84,445	104,770	0.014	
	3	763,100,000	107,502	133,212	0.017	
	4	778,950,000	81,435	101,161	0.013	0.014
2	1	798,486,445	57,191	71,045	0.009	
	2	747,145,230	122,524	152,393	0.020	
	3	762,966,788	67,549	84,016	0.011	
	4	778,848,839	79,421	98,660	0.013	0.013
3	1	798,415,400	43,515	52,302	0.007	
	2	746,992,837	48,264	58,079	0.008	
	3	762,882,772	54,190	65,054	0.009	
	4	778,750,179	52,204	62,670	0.008	0.008
6	1	798,363,098	101,370	126,554	0.016	
	2	746,934,758	100,960	126,358	0.017	
	3	762,817,718	146,363	184,569	0.024	
	4	778,687,509	128,485	160,606	0.021	0.007

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TABLE VI continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
9	1	798,236,544	80,355	99,820	0.013	
	2	746,808,400	142,603	176,708	0.024	
	3	762,633,149	136,562	169,853	0.022	
	4	778,526,903	115,290	143,933	0.018	0.006
13	1	798,136,724	118,433	147,856	0.019	
	2	746,631,692		Sample Lost		
	3	762,463,296	123,103	154,071	0.020	
	4	778,382,970	257,019	319,675	0.041	0.007
16	1	797,988,868	168,869	210,298	0.026	
	2	746,511,692	135,451	169,102	0.023	
	3	762,309,225	113,975	142,291	0.019	
	4	778,063,295	67,556	84,234	0.011	0.007
20	1	797,778,570	249,326	312,048	0.039	
	2	746,342,590	315,407	393,767	0.053	
	3	762,166,934	164,153	205,706	0.027	
	4	777,979,061	72,346	90,320	0.012	0.008

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TABLE VI continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpma	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
28	1				0.034	
	2	797,466,522	215,467	267,661	(0.091)	
	3	745,948,823	(546,398)	(677,073)	0.034	
	4	761,961,228	205,711	257,461	0.013	
		777,888,741	85,761	104,971		
35	1				0.015	0.003
	2	797,198,861	93,581	117,269	(0.074)	
	3	745,271,750	(444,394)	(552,729)	0.034	
	4	761,703,767	204,449	256,202	0.021	
		777,783,770	130,840	164,786		
42	1				0.016	0.003
	2	797,081,592	103,792	130,885	(0.205)	
	3	744,719,021	(1,234,517)	(1,527,868)	0.023	
	4	761,447,565	140,597	176,187	0.012	
		777,618,984	72,758	90,948		
49	1				0.018	0.002
	2	796,950,707	112,689	140,160	(0.626)	
	3	743,191,153	(3,846,100)	(4,650,665)	0.022	
	4	761,271,378	135,819	169,350	0.014	
		777,528,036	85,788	107,101		
						0.003

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TABLE VI continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
56	1	796,810,547	189,703	236,243	0.030	
	2	738,540,488	(352,062)	(437,888)	(0.059)	
	3	761,102,028	96,884	120,653	0.016	
	4	777,420,935	133,998	166,457	0.021	
63	1	796,574,304	146,792	184,877		0.003
	2	738,102,600	(320,462)	(398,585)	0.023	
	3	760,981,375	136,004	169,793	(0.054)	
	4	777,254,478	115,290	143,574	0.022	
70	1	796,389,427	105,102	129,916	0.018	0.003
	2	737,704,015	(302,980)	(375,440)	0.016	
	3	760,811,582	100,858	125,134	(0.051)	
	4	777,110,904	96,482	119,556	0.016	
77	1	796,259,511	104,882	129,965	0.015	0.002
	2	737,328,575	(191,888)	(240,160)	0.016	
	3	760,686,448	92,022	114,171	(0.033)	
	4	776,991,348	136,376	168,991	0.015	
					0.022	0.002

MCL 0231

TABLE VI continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net cpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity
98	1	796,129,546	173,260	215,230	0.027	
	2	737,088,415	(293,205)	(366,506)	(0.050)	
	3	760,572,277	182,765	226,756	0.030	
	4	776,822,357	170,598	211,398	0.027	
119	1	795,914,316	165,787	212,547	0.027	0.001
	2	736,721,909	98,325	126,058	0.017	
	3	760,345,521	156,200	200,000	0.026	
	4	776,610,959	136,004	174,141	0.022	
147	1		Contaminated Sample			0.001
	2		Contaminated Sample			
	3	760,145,521	438,546	559,370	0.074	
	4		Contaminated Sample			
161	1	795,701,769	226,707	290,650	0.037	0.003
	2	736,595,851	194,125	248,878	0.034	
	3	759,586,151	117,736	151,526	0.020	
	4	776,436,818	173,863	222,616	0.029	
						0.002

TABLE VI continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group II (1.0 percent)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
183	1	795,411,119	153,560	196,368	0.025	
	2	736,346,973	(1,030,877)	(1,311,548)	(0.178)	
	3	759,434,625	282,436	360,250	0.047	
	4	776,214,202	197,578	252,657	0.033	
211	1	795,214,751	375,889	478,230	0.060	0.002
	2	735,035,425	300,250	382,972	0.052	
	3	759,074,375	132,275	168,503	0.022	
	4	775,961,545	108,175	137,978	0.018	
						0.001

[a] Net cpm is defined as sample count rate per minute (cpm) minus background count rate (50 cpm).
[b] Net dpm is defined as net cpm corrected for counting efficiency to 100 percent (dpm).

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TABLE VII

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group III (1 ppm)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
1	1	2,374,500	804	1,009	0.042	
	2	2,374,500	939	1,180	0.050	
	3	2,374,500	786	1,003	0.042	
	4	2,374,500	1,214	1,518	0.064	
						0.050
3	1	2,373,491	1,020	1,278	0.054	
	2	2,373,320	1,668	2,201	0.093	
	3	2,373,497	1,458	1,827	0.077	
	4	2,372,982	1,324	1,657	0.070	
						0.037
7	1	2,372,213	1,280	1,602	0.068	
	2	2,371,119	1,352	1,686	0.071	
	3	2,371,670	1,027	1,279	0.054	
	4	2,371,325	1,720	2,150	0.091	
						0.018
14	1	2,370,611	902	1,128	0.048	
	2	2,369,433	993	1,241	0.052	
	3	2,370,391	768	956	0.040	
	4	2,369,175	1,488	1,855	0.078	
						0.008

TABLE VII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group III (1 ppm)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpma	Net dpmb	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
21	1	2,369,483	972	1,220	0.051	
	2	2,368,192	864	1,084	0.046	
	3	2,369,435	920	1,150	0.049	
	4	2,367,320	1,543	1,919	0.081	
28	1	2,368,263	1,180	1,468	0.062	0.008
	2	2,367,108	1,239	1,537	0.065	
	3	2,368,285	1,079	1,340	0.057	
	4	2,365,401	1,675	2,091	0.088	
35	1	2,366,795	1,958	2,444	0.103	0.010
	2	2,365,571	2,170	2,712	0.115	
	3	2,366,945	1,701	2,129	0.090	
	4	2,363,310	1,397	1,740	0.074	
42	1	2,364,351	1,515	1,887	0.080	0.014
	2	2,362,859	2,118	2,638	0.112	
	3	2,364,816	1,349	1,674	0.071	
	4	2,361,570	1,359	1,684	PAGE 0204-2	
						0.012

TABLE VII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group III (1 ppm)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
49	1	2,362,464	1,320	1,646	0.070	
	2	2,360,221	1,354	1,676	0.071	
	3	2,363,142	1,450	1,810	0.077	
	4	2,359,886	1,405	1,751	0.074	
						0.010
70	1	2,360,818	1,994	2,499	0.106	
	2	2,358,545	2,147	3,919	0.166	
	3	2,361,332	1,758	2,198	0.093	
	4	2,358,135	1,655	2,098	0.089	
						0.005
91	1	2,358,319	943	1,276	0.054	
	2	2,354,626	1,103	1,436	0.061	
	3	2,359,134	499	657	0.028	
	4	2,356,037	1,418	2,052	0.087	
						0.003
119	1	2,357,043	5,496	7,028	0.298	
	2	2,353,190	3,565	4,541	0.193	
	3	2,358,477	3,868	4,934	0.209	
	4	2,353,985	4,183	5,342	0.227	
						0.008

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TABLE VII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Test Group III (1 ppm)

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
155	1	2,350,015	4,394	5,633	0.240	
	2	2,348,649	2,928	3,739	0.159	
	3	2,353,543	5,188	6,617	0.281	
	4	2,348,643	4,420	5,740	0.244	
183	1	2,344,382	2,220	2,839		0.006
	2	2,344,910	3,318	4,253	0.121	
	3	2,346,926	2,104	2,694	0.181	
	4	2,342,903	3,963	5,061	0.115	
					0.216	0.006

a Net cpm is defined as sample count rate per minute (cpm) minus background count rate (50 cpm).

b Net dpm is defined as net cpm corrected for counting efficiency to 100 percent (dpm).

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TABLE VIII

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
1	1	12,117,000	2,631,551	3,224,940	26.62	
	2	12,175,000	2,777,750	3,404,105	27.96	27.29
	5	13,728,000	2,325,529	2,853,410	20.78	
	6	12,761,550	2,173,861	2,673,876	20.95	20.86
2	1	8,892,060	337,812	418,602	4.71	
	2	8,770,895	345,995	429,274	4.89	4.80
3	1	8,473,458	429,135	515,787	6.09	
	2	8,341,621	434,733	522,516	6.26	6.18
	5	10,874,590	1,428,520	1,763,605	16.22	
	6	10,087,674	1,219,461	1,509,234	14.96	7.80
6	1	7,957,671	1,075,218	1,329,070	16.70	
	2	7,819,105	1,136,312	1,404,588	17.96	5.78

Industrial BIO-TEST Laboratories Inc.

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TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
7	5	9,110,985	2,272,725	2,795,480	30.68	
	6	8,578,440	1,923,025	2,368,257	27.61	7.28
9	1	6,628,601	854,650	1,059,046	15.98	
	2	6,414,517	892,806	1,104,958	17.23	5.53
13	1	5,569,555	833,282	1,032,568	18.54	
	2	5,309,559	900,850	1,114,913	21.00	4.94
14	5	6,315,505	1,111,060	1,373,374	21.75	
	6	6,210,183	999,949	1,237,561	19.93	2.98

TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
16	1	4,536,987	304,878	378,730	8.35	
	2	4,194,646	396,775	492,888	11.75	3.35
20	1	4,158,257	263,802	328,521	7.90	
	2	3,701,758	368,953	458,897	12.40	2.54
21	5	4,942,131	295,808	367,007	7.43	
	6	4,972,622	281,640	349,429	7.03	1.03
28	1	3,829,736	326,744	405,393	10.58	
	2	3,242,861	346,020	429,305	13.24	1.49
	5	4,575,124	157,679	195,632	4.28	
	6	4,623,193	147,879	183,245	3.96	0.59

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TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpma	Net dpmb	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
35	1	8,954,343c	2,941,124	3,604,319	40.25	
	2	9,313,556c	2,777,725	3,408,252	36.60	
	5	4,379,492	172,662	214,487	4.90	5.49
	6	4,439,948	147,009	182,620	4.11	
42	1	5,350,024	577,984	717,102	13.40	
	2	5,905,304	666,616	826,042	13.99	0.64
	5	4,165,005	107,477	133,016	3.19	
	6	4,257,328	206,135	255,118	5.99	1.96
49	1	4,632,922	226,707	281,624	6.08	
	2	5,079,262	230,897	286,473	5.64	0.66
	5	4,031,989	83,844	104,025	2.58	
	6	4,002,210	101,991	126,383	3.18	0.84
56	1	4,351,298	144,250	179,193	4.12	
	2	4,792,789	139,226	172,737	3.60	0.41

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TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
63	1	4,172,105	130,158	161,888	3.88	
	2	4,620,052	109,240	135,702	2.94	0.49
70	1	4,010,217	129,652	160,659	4.01	
	2	4,484,350	79,806	98,892	2.20	0.44
	5	3,927,964	234,692	291,543	7.42	
	6	3,875,827	222,667	276,605	7.14	0.35
77	1	3,849,558	144,459	178,786	4.64	
	2	4,385,458	106,220	131,460	3.00	0.55
91	5	3,636,421	(24,262)[d]	(31,550)	(0.87)	
	6	3,599,222	137,881	175,645	4.88	0.23

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TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
98	1	3,670,772	216,400	269,825	7.35	1.01
	2	4,253,998	230,365	286,524	6.74	
119	1	3,400,947	137,501	174,938	5.14	0.16
	2	3,967,474	49,127	62,582	1.58	
	5	3,604,871	(3,032)[d]	(3,867)	(0.11)	0.13
	6	3,423,577	97,907	124,722	3.64	
147	1	3,226,009	90,603	115,271	3.57	0.12
	2	3,904,892	93,408	118,991	3.13	
155	5	3,601,004	(7,760)[d]	(9,911)	(0.28)	0.14
	6	3,298,855	129,652	165,584	5.02	

TABLE VIII continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group - Glucose

Test Day Number	Flask Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
183	1	3,110,738	103,470	132,146	4.25	
	2	3,785,901	69,269	88,693	2.34	0.09
	5	3,591,093	(18,373)[d]	(23,555)	(0.66)	
	6	3,133,271	86,514	111,058	3.54	0.13
211	1	2,978,592	60,782	77,627	2.61	
	2	3,697,208	39,101	49,874	1.35	0.07

[a] Net cpm is defined as sample count rate per minute (cpm) minus background count rate (50 cpm).
[b] Net dpm is defined as net cpm corrected for counting efficiency to 100 percent (dpm).
[c] On Test Day 29 additional ^{14}C-D-Glucose was added to medium (Flask 1: 5.53×10^6 dpm; Flask 2: 6.50×10^6 dpm).
[d] Media in Flask 5 was accidentally contaminated with KOH solution. These data have not been included in the remaining average daily $^{14}CO_2$ liberation rates.

TABLE IX

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group (H_2O-$HgCl_2$)

Test Day Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
1	2,374,500	7ifb	0	0.000	0.000
3	2,374,500	54	70	0.003	0.002
7	2,374,430	7ifb	0	0.000	0.000
14	2,374,430	0	0	0.000	0.000
21	2,374,430	75	98	0.004	0.001
35	2,374,332	23	30	0.001	<0.001
42	2,374,302	4ifb	0	0.000	0.000
49	2,374,302	1,110	1,386	0.058	0.008
70	2,372,916	112	144	0.006	<0.001
91	2,372,772	255	435	0.018	0.001

fb = indistinguishable from background count rate

TABLE IX continued

TEST MATERIAL: MC-680

Biodegradability Study With ^{14}C-MC-680

^{14}C Activity Respired as $^{14}CO_2$ - Control Group (H_2O-$HgCl_2$)

Test Day Number	Total Theoretical Substrate ^{14}C Activity (dpm)	Net cpm[a]	Net dpm[b]	Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)	Average Daily Rate of $^{14}CO_2$ Liberation (Percent of Total ^{14}C Activity)
119	2,372,337	689	882	0.037	0.001
155	2,371,455	1,307	1,671	0.070	0.002
183	2,369,784	457	589	0.025	0.001

Net cpm is defined as sample count rate per minute (cpm) minus background count rate (50 cpm) minus background count rate (50 cpm).
Net dpm is defined as net cpm corrected for counting efficiency to 100 percent (dpm).

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8ENQ-0678-0184(X)

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

REPORT TO

MICHIGAN CHEMICAL CORPORATION

PRIMARY SKIN IRRITATION TEST WITH
MOTHER LIQUOR 680 PROCESS, CODE NO. 7-29-76-B
IN ALBINO RABBITS

P.O. NO. 24678-A

OCTOBER 25, 1976

IBT NO. 8530-09618

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Industrial **BIO-TEST** *Laboratories, Inc.*
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

October 25, 1976

Mr. R. C. Nametz, Group Leader
Application Development
Michigan Chemical Corporation
2 North Riverside Plaza
Chicago, Illinois 60606

PAGE 0255

Dear Mr. Nametz:

Re: IBT No. 8530-09618 - Primary Skin Irritation Test with Mother Liquor 680 Process, Code No. 7-29-76-B in Albino Rabbits - P.O. No. 24678-A

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC:bp

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REPORT TO

MICHIGAN CHEMICAL CORPORATION

PRIMARY SKIN IRRITATION TEST WITH
MOTHER LIQUOR 680 PROCESS, CODE NO. 7-29-76-B
IN ALBINO RABBITS

P.O. NO. 24678-A

OCTOBER 25, 1976

IBT NO. 8530-09618

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I. Introduction

At the request of the Michigan Chemical Corporation, a primary skin irritation test was conducted with a clear red liquid identified as Mother Liquor 680 Process, Code No. 7-29-76-B.

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II. Summary

The results of the primary skin irritation test in albino rabbits indicated that Mother Liquor 680 Process, Code No. 7-29-76-B, was Mildly Irritating (1.9/8.0).

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

Report prepared by: Ronald G. Baker

Ronald G. Baker, B.S.
Assistant Group Leader
Local Tissue Toxicity

Report approved by: C. W. Mastri

C. W. Mastri, B.S.
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jd

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III. Results

The results of the primary skin irritation test are presented in the following table:

MRID 0258

TABLE

Primary Skin Irritation Test - Albino Rabbits

Results

IBT No.: 8530-09618
Test Material: Mother Liquor 680 Process, Code No. 7-29-76-B
Form Administered: 0.5 ml, undiluted
Special Instructions: 24-hour exposure period; occluded sites

Classification: Mildly Irritating
Mean Primary Irritation Score: 1.9/8.0

Animal Number	Irritation Scores for Abraded Skin Sites at: 24 Hours Er.	24 Hours Ed.	72 Hours Er.	72 Hours Ed.	Irritation Scores for Intact Skin Sites at: 24 Hours Er.	24 Hours Ed.	72 Hours Er.	72 Hours Ed.
1	3	0	2	0	3	0	2	0
2	3	0	1	0	3	0	1	0
3	2	0	2	0	2	0	2	0
4	2	0	1	0	2	0	1	0
5	2	0	0	0	2	0	0	0
6	3	0	2	0	3	0	2	0
Mean	2.5	0.0	1.3	0.0	2.5	0.0	1.3	0.0
Subtotal	3.8				3.8			

Primary Irritation Score = 1.9

Key:
Er. = Erythema
Ed. = Edema

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0387

IV. Appendix

The detailed investigational procedure employed in this study is presented in the following pages:

PAGE 0260

PRIMARY SKIN IRRITATION TEST - ALBINO RABBITS

Young albino rabbits of the New Zealand strain were used in the evaluation of the primary skin irritating properties of the test material. The test procedure was modeled after that of Draize et al.*

Prior to the application of the test material, the hair was clipped from the back and flanks of each rabbit. Two test sites located lateral to the midline of the back approximately ten centimeters apart were selected. One of the two sites was abraded by making four epidermal incisions, two perpendicular to the other two, while the other test site remained intact.

PAGE 0261

The test material was applied to each of the test sites on each rabbit and occluded with gauze patches which were secured with masking tape. The trunk of each animal was then wrapped with impervious plastic sheeting. The wrap held the patches in position and retarded evaporation of the test material during the 24-hour exposure period.

At the end of 24 hours, the plastic wrappings, patches, and all residual test material were removed. The intact and abraded test sites were examined and scored separately for erythema and edema on a graded scale of 0 to 4. After 72 hours, the sites were again examined and scored.

* Draize, John H., Woodard, Geoffrey, and Calvery, Herbert O., "Methods for the Study of Irritation and Toxicity of Substances Applied Topically to the Skin and Mucous Membranes," J. Pharm. & Exp. Ther. 82, 377 (1944).

0384

In evaluating the average irritation present, the mean scores for erythema and edema of the intact test sites after 24 and 72 hours were added. Similarly, the mean scores for erythema and edema of the abraded test sites after 24 and 72 hours were added. These two values were totaled and divided by four to obtain the mean primary irritation score.

The following grading system was used to arrive at a descriptive primary skin irritation rating:

Mean Primary Irritation Score (Range of Values)	Descriptive Rating
0	Nonirritating
0.1 - 0.5	Minimally Irritating
0.6 - 1.5	Slightly Irritating
1.6 - 3.0	Mildly Irritating
3.1 - 5.0	Moderately Irritating
5.1 - 6.5	Severely Irritating
6.6 - 8.0	Extremely Irritating

PAGE 0262

The scoring criteria for erythema and edema are shown in the following table:

TABLE

Primary Skin Irritation Test - Albino Rabbits

Scoring Criteria for Skin Reactions

Reactions	Description	Score
Erythema	Barely perceptible (Edges of area not defined)	1
	Pale red in color and area definable	2
	Definite red in color and area well-defined	3
	Beet or crimson red in color	4
Edema	Barely perceptible (Edges of area not defined)	1
	Area definable but not raised more than 1 mm	2
	Area well-defined and raised approximately 1 mm	3
	Area raised more than 1 mm	4
Injury In Depth	Escharosis, Necrosis	8
	Maximum Primary Irritation Score =	8

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8EHQ-0678-0184 (3)

88-7800184

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

December 6, 1976

Mr. Peter H. Burleigh, Supervisor
Thermoplastics Research
Michigan Chemical Corporation
2 North Riverside Plaza
Chicago, Illinois 60603

Dear Mr. Burleigh:

Re: IBT No. 8562-09787 - Acute Heated Vapor Inhalation Toxicity Study with Granulated FM 680 containing Television rings manufactured by Xoba Corporation in Rats

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC/fd

Document declassified on 8-22-78

PAGE 0265

425

0 3 9 2

Industrial BIO-TEST Laboratories, Inc.

REPORT TO MICHIGAN CHEMICAL CORPORATION

ACUTE HEATED VAPOR INHALATION TOXICITY STUDY IN RATS

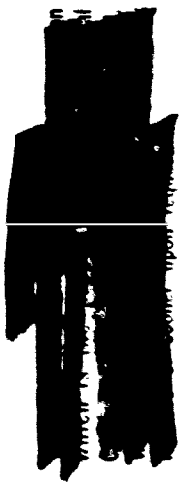
Test Material: Granulated FM 680 containing Television rings manufactured by Xolon Corporation
Form Administered: Heated vapor
Acute LC_{50} > 13.08 mg/l air
Nominal concentration

Strain: Charles River Rats
Exposure Time: 4 hours
Observation Period: 14 days
IBT No. 8562-0 757

Generation of Test Material:

Vapor was generated by passing a stream of clean, dry air (-40 C dew point) over the test material heated to 135 C. The resulting air-vapor mixture was then introduced into the exposure chamber. Particulate matter samples, analytical samples for tribromophenol and the nominal concentration were calculated. Particulate matter and analytical samples were taken [illegible] 2, 3, and 4 hours. Analytical data are presented on page 3.

Chamber Conditions		Atmospheric		
Group No.	Size (liters)	Pressure (inches Hg)	Temperature (°C)	Air Flow (l/min)
Test	80	29.96	26	2.0



Results		Concentrations				
Group No.	Total Number of Animals Male/Female	Particulate Matter (mg/l)	Nominal	Mortality Male	Mortality Female	Weight Gain Male/Female (%)
Test	5/5	0.[illegible] mg/l air	13.08 mg/l air	0/5	0/5	[illegible]

The hourly values used to determine the mean are presented in the table on page 3.

Remarks

There were no deaths or untoward reactions observed during the exposure or the 14-day observation period which followed. The average 2-[illegible] body weight gains were within the normal limits. Necropsy, performed on all rats at the end of the observation period, did not reveal any gross pathologic alterations that were attributable to the effects of the test material.

Respectfully submitted,
INDUSTRIAL BIO-TEST LABORATORIES, INC.

Prepared by: [signature]
Larry L. Foreth, B.S.
Assistant Toxicologist
Inhalation Toxicity

Approved by: [signature]
John W. Goode, Ph. D.
Manager
Decatur Research Laboratories

426

0393

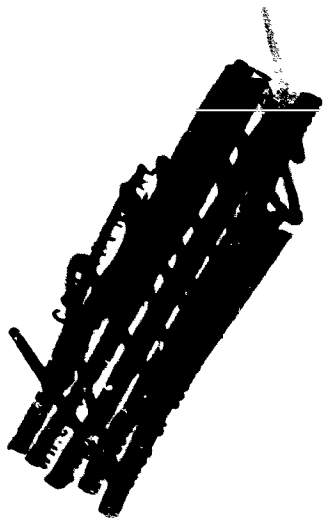
TABLE

TEST MATERIAL: Granulated FM 680

Acute Heated Vapor Inhalation Toxicity Study - Rats

Time	Particulate Matter Concentration (mg/l air)
0 hour	0.973
1 hour	0.[illegible]
2 hour	0.[illegible]7
3 hour	0.[illegible]7
4 hour	0.[illegible]0
Mean	0.228

PAGE 0261



0394

ANALYSIS OF CHAMBER ATMOSPHERE

1. Equipment

   a. Hewlett-Packard 5711 gas chromatograph with dual FID.

   b. Hewlett-Packard 3352C laboratory data system

   c. Chart recorder 1 mv full scale

   d. Column: 6' X 1/4" OD 2 mm ID glass

      Coiled column, 3% Reoplex 400 on 80/100 mesh Chromosorb W-AW-DMCS.

   e. 5 µl liquid syringe (Hamilton Co.)

   f. Gelman Type A filters

2. Conditions

   Column oven 195° C

   FID 250° C

   Injection port 150° C

   N_2 carrier flow 51 ml/min

3. Calibration

   Tribromosphenol was diluted in methanol to achieve the following concentrations: 0.05, 0.1, 0.5, 0.8, and 1.0 mg TBP/ml. One µl volumes were injected into the gas chromatograph and the peak count was computer integrated and plotted. Using the formula $\frac{\text{concentration}}{\text{area count}} = RF$ (response factor) a mean response factor was determined for this calibration range. This factor was used in the external standard method of the HP data system to determine the concentration of chamber samples.

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4. Chamber Sampling

Chamber air was passed through a Gelman Type A filter at a rate of one l/min for 15 minutes. Air passing through the filter was then bubbled through 15 ml methanol. The filter samples were weighed and then 10 ml of methanol was added. Each filter was well mixed with methanol to extract the TBP and one µl volumes were injected to determine the concentration in mg/ml. No TBP was found in the methanol back-up. The following formula was used to determine the chamber concentration.

$$\frac{\text{mg TBP/ml} \times 10 \text{ ml}}{15 \text{ liters air}} = \text{mg/l TBP}$$

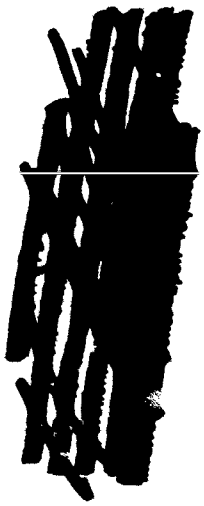
MAE 0269

5. Results

a. Sample No. 1

0 - Hour - $\frac{0.0789 \text{ mg/ml} \times 10 \text{ ml}}{15 \text{ l}}$ = 0.0526 mg/l

b. 1 - Hour - Below detectable limit.



88-7800184 8EHQ-0678-0184 (2)

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

PAGE 0211

REPORT TO

MICHIGAN CHEMICAL CORPORATION

SKIN SENSITIZATION TEST WITH MOTHER LIQUOR 680 PROCESS IN ALBINO GUINEA PIGS

P.O. NO. 24678-A

DECEMBER 8, 1976

IBT NO. 8530-09618

430

0397

Industrial BIO-TEST Laboratories Inc
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

PAGE 0212

Mr. R. C. Nametz, Group Leader
Application Development
Michigan Chemical Corporation
1917 Green Road
Ann Arbor, Michigan 48105

Dear Mr. Nametz:

Re: IBT No. 8530-09618 - Skin Sensitization Test with Mother Liquor 680 Process in Albino Guinea Pigs - P. O. No. 24678-A

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC: dm

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MAY 1984
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REPORT TO

MICHIGAN CHEMICAL CORPORATION

SKIN SENSITIZATION TEST WITH
MOTHER LIQUOR 680 PROCESS
IN ALBINO GUINEA PIGS

P.O. NO. 24678-A

DECEMBER 8, 1976

IBT NO. 8530-09618

I. Introduction

At the request of the Michigan Chemical Corporation, a skin sensitization test in albino guinea pigs was conducted with a dark, red liquid identified as Mother Liquor 680 Process, Code No. 7-29-76-B.

II. Summary

The results of the skin sensitization test indicate that Mother Liquor 690 Process is Not a Sensitizer.

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES INC.

Report prepared by: Terry W. Davis

Terry W. Davis, B.S.
Assistant Group Leader
Biological Evaluations

Report approved by: C. W. Mastri

C. W. Mastri, B.S.
Section Head, Acute Toxicity

Florence K. Kinoshita

Florence K. Kinoshita, Ph.D.
Technical Manager, Toxicology

M. L. Keplinger

M. L. Keplinger, Ph.D.
Manager, Toxicology

dm

PAGE 02 714

433

III. Results

The results of the skin sensitization test are presented in Tables I through III.

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TABLE I

Skin Sensitization Test - Albino Guinea Pigs

Results - Irritation Range-Finding Group

IBT No.: 8530-09618
Test Material: Mother Liquor 680 Process
Form Administered: 0.5 ml per site, aqueous solutions
Special Instructions: 5-hour exposure period

Concentration	Animal Number	Irritation Scores Following Range-Finding Application At: Site 1 24 Hours	Site 1 48 Hours	Site 2 24 Hours	Site 2 48 Hours
Undiluted	1	0	0	0	0
	2	0	0	0	0
10.0 percent (w/v)	3	0	0	0	0
	4	0	0	0	0
1.0 percent (w/v)	5	0	0	0	0
	6	0	0	0	0
0.1 percent (w/v)	7	0	0	0	0
	8	0	0	0	0

PAGE 0216

TABLE II

Skin Sensitization Test - Albino Guinea Pigs

Results - Test Group

IBT No.: 8530-09618

Test Material: Mother Liquor 680 Process

Form Administered: 0.5 ml per site, insult applications undiluted

Special Instructions: 5-hour exposure period

Classification: Not a Sensitizer

Animal Number	Irritation Scores 24 Hours After Insult Application Number: 1										Irritation Scores Following Challenge Application No. 1 At:				Irritation Scores Following Challenge Application No. 2 At:	
	24 Hours	48 Hours**	2	3	4	5	6	7	8	9	Insult Site 24 Hours	Insult Site 48 Hours	Virgin Site 24 Hours	Virgin Site 48 Hours	Virgin Site 24 Hours	Virgin Site 48 Hours
1	0	0	0	0	0	*	0	0	0		0	0	0	0	0	0
2	0	0	0	0	0	*	±	0	0		0	0	0	±	0	0
3	0	0	0	0	±	*	±	0	±		0	±	0	0	0	0
4	0	0	0	0	±	*	±	0	±		0	0	0	0	0	0
5	0	0	0	0	1	*	1	±	±		0	±	0	0	0	0
6	0	0	0	±	0	1	*	1	±	±	0	0	0	0	0	0
7	0	0	0	0	±	*	±	0	±		0	±	0	±	0	0
8	0	0	0	0	±	*	±	±	0		±	0	±	0	0	0
9	0	0	0	0	±	*	±	0	0		1	1	±	±	0	0
10	0	0	0	±	0	*	±	0	0		±	±	±	±	0	0

Note: The irritation scores noted after challenge No. 1 were regarded as primary irritation reactions since both the test group and control group exhibited the reactions. Challenge No. 2 was dosed 2 days after challenge No. 1.

* No reading taken after application No. 6.

** The 48-hour scores were recorded for comparison with challenge data.

Challenge Application No. 1 was applied undiluted.

Challenge Application No. 2 was applied as 10.0% (w/v) aqueous

TABLE III

Skin Sensitization Test - Albino Guinea Pigs

Results - Irritation Control Group

IBT No.: 8530-09618
Test Material: Mother Liquor 680 Process
Form Administered: 0.5 ml per site at concentrations indicated below
Special Instructions: 5-hour exposure period

Animal Number	Irritation Scores Following Challenge Application No. 1 At: Insult Site 24 Hours	Insult Site 48 Hours	Virgin Site 24 Hours	Virgin Site 48 Hours	Irritation Following C Application N Virgin 24 Hours
1	±	±	0	±	0
2	1	±	±	±	0
3	±	±	±	±	0
4	±	±	±	±	0

Note: Challenge Application No. 1 applied undiluted.
Challenge Application No. 2 applied as 10.0% (w/v) aqueous solution.

IV. Appendix

The detailed investigational procedure employed in this study is presented in the following pages:

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SKIN SENSITIZATION TEST - ALBINO GUINEA PIGS

Ten albino guinea pigs were used to evaluate the skin sensitizing properites of the test material. The test procedure employed was modeled after that of E. V. Buehler*.

Prior to the test, the irritation threshold of the test material in the appropriate vehicle was established. Each animal was then insulted with a single closed patch containing the maximum nonirritating concentration of the test material for a total of 9 times. Closed patches were applied to the guinea pigs in the following manner: A Webril pad containing 0.5 ml of the test material solution was applied near the midline of the shaved back of each animal. The Webril pad was occluded with a standard size Elastoplast coverlet (1½ inch x 2 inches) and each animal was placed in a guinea pig restrainer for 5 hours.

Two weeks after the last exposure, the test animals and 4 control animals taken from the same population were challenged with duplicate patches. The application sites were graded for irritation 24 and 48 hours after the initial insult, 24 hours after each intermediate insult and 24 and 48 hours after challenge. Any reaction among the test animals at challenge that was greater than that noted after the initial insult or greater than that noted among the control animals at challenge was considered evidence of sensitization.

The scoring criteria for skin irritation are presented in the following table:

* Buehler, E. V. "Delayed Contact Hypersensitivity in the Guinea Pig," Arch. Dermat. 91, February 1965.

0 4 0 6

TABLE

Skin Sensitization Test - Albino Guinea Pigs

Scoring Criteria for Skin Reactions

Reaction		Score
No reaction		0
Minimal erythema	(Barely perceptible and edges of area not defined)	±
Slight erythema	(Pale red in color and area defined)	1
Moderate erythema	(Red in color and area well defined)	2
Moderate erythema and edema	(Red in color and area well defined)	3
Severe erythema and moderate edema and cracking of skin	(Beet or crimson red in color)	4

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0 4 0 7

TOXICITY SUMMARY REPORT

COMPOUND:	Mother Liquor 680 Process.
TESTING LABORATORY:	Industrial Bio-Test Laboratory
DATE:	December 8, 1976
SUBJECT:	Skin sensitization test with Mother Liquor 680 Process in albino guinea pigs.
OBJECTIVE:	The study was conducted to evaluate the potential skin sensitization effects of Mother Liquor 680 Process.
PROCEDURE:	Ten guinea pigs were used to evaluate the skin sensitizing properties of the test material. Each animal was insulted with a single closed patch containing the material for a total of 9 times. Two weeks after the last exposure, the test animals and controls were challenged with close patch containing the same amount of material.
RESULTS:	The results of the skin sensitization test indicate that Mother Liquor 680 Process is NOT a sensitizer.
CONCLUSION:	Although Mother Liquor 680 Process was not a sensitizer as measured by the guinea pig skin sensitization test, it caused primary skin irritation and therefore, care should be taken to avoid repeated or prolonged skin contact.

BJT 0282

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88-7800184

8EHQ-0678-0184 (A)

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

PAGE 0284

REPORT TO

MICHIGAN CHEMICAL CORPORATION

90-DAY SUBACUTE ORAL TOXICITY STUDY WITH FIREMASTER® 680 IN ALBINO RATS

P.O. NO. 21981-A

JANUARY 6, 1977

IBT NO. 8532-08925

442

0409

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

8532

Dr. A. Fred Kerst, Vice President
Research & Development
Technical Center
1975 Green Road
Ann Arbor, Michigan 48105

Dear Dr. Kerst:

Re: IBT No. 8532-08925 - 90-Day Subacute Oral Toxicity Study with FireMaster® 680 (Lot No. 60356-A) in Albino Rats - P.O. No. 21981-A

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC:trm

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0411

REPORT TO

MICHIGAN CHEMICAL CORPORATION

90-DAY SUBACUTE ORAL TOXICITY STUDY WITH FIREMASTER® 680 IN ALBINO RATS

P.O. NO. 21981-A

JANUARY 6, 1977

IBT NO. 8532-08925

I. Introduction

A sample identified as FireMaster® 680 (Lot No. 60356-A) was received from Michigan Chemical Corporation for the purpose of conducting a 90-day subacute oral toxicity study using the albino rat as the test species. The following report presents the results of this investigation.

U. Summary

A 90-day subacute oral toxicity study was conducted in which groups of albino rats were fed dietary concentrations of 0, 0.1, 1.0, or 10.0% of FireMaster® 680 in the diet. The following results were obtained during the investigation:

A. Body Weights

The body weights and body weight gains among the test groups compared favorably with those of the control groups.

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B. Food Consumption

The average food consumption among test animals was similar to that of the controls.

C. Mortality and Reactions

Fourteen animals succumbed during the study. Eleven of the deaths occurred immediately after the collection of blood. Two deaths were noted in the control group (19-F, 28-F), 1 death in the 0.1% group (46-F), 2 deaths in the 1.0% group (77-F, 81-F), and 6 deaths in the 10% group (109-F, 110-F, 111-F, 112-F, 113-F, 118-F). The cause of death was not determined for the other 3 rats (Control 2-M, 4-M, 16-F). Gross pathologic examination of these animals did not reveal any correlation between death and exposure to the test material. No abnormal behavioral reactions were noted among any of the animals in the study.

D. Hematologic Studies

The results of the hematologic studies conducted, including total leukocyte count, erythrocyte count, hemoglobin concentration, hematocrit

0 4 1 3

value, and differential leukocyte count, revealed no changes which could be related to the ingestion of the test material. The values among test animals were well within the normal range for animals of this age and strain.

E. Clinical Blood Chemistry Studies

Slight increases were noted in the serum alkaline phosphatase (SAP) activity among males (not females) fed 10% FireMaster ® 680 at 40 and 84 days of testing. Evaluation of lower test groups (0.1 and 1.0%) at 84 days revealed values which were similar to those of the controls. No biologically significant changes were noted in the serum glutamic pyruvic transaminase (SGPT) activity, blood urea nitrogen (BUN) concentration, and fasting blood glucose concentration.

F. Urinalyses

The results of the urinalyses conducted during the study, including glucose, albumin, pH, specific gravity, and microscopic elements examination, were similar for both test and control animals.

G. Pathologic Studies

No treatment-related gross pathologic changes were noted. The results of the statistical analyses conducted on absolute organ weights and ratios revealed no treatment-related alterations among any of the groups tested.

Histopathological examination of test animals fed 10% FireMaster ® 680 revealed treatment-related hepatic changes among most animals in this group. The lesion consisted of either focal or multifocal enlargement

PAGES 2 TO

0 4 1 4

(hypertrophy) of hepatocytes located within the centrilobular to midzonal regions of affected liver lobules. The severity was graded as minimal and the incidence was higher among male test animals. No treatment-related changes were evident among animals fed either 0.1 or 1.0%. The other changes recorded were lesions of naturally occurring diseases and they were present, in most cases, among both the control and test animals.

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

Report prepared by:

Andrew J. Marias, B.S.
Group Leader
Rodent Toxicity

Report approved by:

Gerald L. Kennedy, Jr., B.S.
Section Head, Toxicology

Florence K. Kinoshita, Ph.D.
Technical Manager, Toxicology

M. L. Kepkinger, Ph.D.
Manager, Toxicology

trm

PAGE 0290

0415

III. Procedure

A. Experimental Animals

The animals employed in the study were Charles River strain* albino rats. One hundred-twenty rats (60 males and 60 females) were received at this laboratory at 21 days of age. The rats were adapted to the caging and demand-operated water system for 8 days, and were divided randomly into 1 control and 3 test groups. Feeding of the test material was initiated when the animals were 29 days of age. Animals were housed individually in standard, wire-bottomed steel cages. Each cage bore a color-coded card identifying the animal with respect to project number, dietary level assignment, individual animal number, and sex.

PAGE 0291

B. Organization of Groups

A structural outline of the experiment is shown in Table I.

* Charles River Breeding Laboratories, Inc., Wilmington, Massachusetts.

0 4 1 6

TABLE I

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Outline of Experiment

Group	Dietary Level (%)	Number of Animals Males	Number of Animals Females
Control	0	15	15
T-I	0.1	15	15
T-II	1.0	15	15
T-III	10.0	15	15

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0 4 1 1

C. Body Weights

Each animal used in the study was weighed on the first day of the test and at weekly intervals thereafter. The weights were recorded and served as an index to growth.

D. Diet Preparation

The diet for the test groups was prepared by blending the appropriate amount of FireMaster® 680 (Lot No. 60356-A) with standard rat ration* in a high-speed blender. Fresh diets were prepared each week. Each rat was offered an amount of diet sufficient for 1 week's ad libitum feeding. However, checks were made daily to ensure that food was available at all times.

E. Food Consumption Data

Food consumption data were collected individually from 5 rats of each sex in each group weekly during the study.

* Purina Rat Chow (dry, pulverized diet), Ralston-Purina Company, St. Louis, Missouri.

FIRE 0292

F. Mortality and Reactions

Observations for abnormal reactions and/or deaths were conducted daily during the investigation.

G. Hematologic Studies, Clinical Blood Chemistry Studies, and Urinalyses

Blood and urine samples were collected individually from 10 rats of each sex from the control and highest dietary level (10.0%) after 40 days and from all test groups at 84 days. Samples were analyzed for the following:

1. Hematologic Studies

   a. Total Leukocyte Count
   b. Erythrocyte Count
   c. Hemoglobin Concentration
   d. Hematocrit Value
   e. Differential Leukocyte Count

2. Clinical Blood Chemistry Studies

   a. Serum Alkaline Phosphatase Activity (SAP)
   b. Serum Glutamic Pyruvic Transaminase Activity (SGPT)
   c. Blood Urea Nitrogen Concentration (BUN)
   d. Fasting Blood Glucose Concentration

3. Urinalyses

   a. Glucose Concentration
   b. Albumin Concentration
   c. pH
   d. Specific Gravity
   e. Microscopic Elements - crystals

PAGE 0294

H. Pathologic Studies

1. Gross Examinations

Following the test period*, all surviving rats were rendered unconscious by exposure to carbon dioxide in a closed chamber and immediately exsanguinated. Animals which died during the study were necropsied and tissues preserved except in cases where advanced autolysis precluded meaningful evaluation. At necropsy, each animal received a complete examination. Specimens of representative protocol required tissues were removed and preserved in 10% neutral buffered formalin fixative.

2. Organ Weights

The weights of the brain, gonads, heart, kidneys, liver, and spleen of each rat were recorded.

3. Microscopic Examination

Microscopic examination was conducted on tissues taken from 10 rats of each sex from the control group and T-III (10%) test group at the final sacrifice. In addition, sections of liver from 10 rats of each sex of the T-I (0.1%) and T-II (1.0%) group were also examined. Tissues, stained with Hematoxylin-Eosin and examined included the following:

* Animals were maintained on test diet for an additional 16 days prior to sacrifice due to an unavoidable scheduling conflict with the necropsy.

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Adrenal Glands
Aorta (thoracic)
Brain (cerebrum, cerebellum, pons)
Caecum
Colon
Epididymis
Esophagus
Eyes with Optic Nerves
Gonads
Heart
Kidneys
Liver
Lung
Lymph Nodes (cervical, mesenteric)
Muscle (skeletal)
Pancreas
Parathyroid Glands
Peripheral Nerve (sciatic)
Pituitary Gland
Prostate Gland
Salivary Gland (submaxillary, sublingual, parotid)
Small Intestine (duodenum, jejunum, ileum)
Spinal Cord
Spleen
Sternum (bone marrow)
Stomach (cardia, fundus, pylorus)
Thyroid Glands
Trachea
Urinary Bladder
Uterus

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I. Statistical Analyses

Body weight data, hematologic data, clinical blood chemistry data, and organ weight data were statistically analyzed. A One-Way Analysis of Variance was conducted first. Significant body weight, hematologic, clinical blood chemistry, or organ weight effects disclosed by this treatment were further analyzed by either the Tukey's (equal population size) or the Scheffe's (unequal population size) Multiple Comparison Test. Organ to body weight and organ to brain weight ratios were statistically analyzed by the Kruskal-Wallis Statistic Test; significant effects disclosed by this treatment were further analyzed by the Kruskal-Wallis Multiple Comparison Test. Statistically significant intergroup differences are indicated in the data tables by asterisks. One asterisk (*) indicates a statistically significant difference at the 95 percent confidence level ($P < 0.05$). Two asterisks (**) indicate a statistically significant difference at the 99 percent confidence level ($P < 0.01$).

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In appraising the data developed in this study, statistical evaluation, as well as historical information developed at these laboratories for rats of this age and strain, have been considered. The presence of statistical significance does not lead per se to the conclusion that test material-related effects are occurring. Normal ranges for various parameters using this strain of rat have been established for a larger population of untreated rats than those used as controls in this particular study providing additional values for the final interpretation of results.

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IV. Results

A. Body Weights

Body weight data collected during the 90-day test period are summarized in Table II. Also included in the table are 90-day average total weight gains. Body weights among test animals compared favorably with those of the controls.

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TABLE II

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Body Weight and Total Weight Gain Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Body Weight (g) Week: 0	1	2	3	4	5	6	7	8	9	10	11	12	13	Total Weight Gain (g/rat)
Control (0)	M	91	150	213	270	322	357	401	(404)	442	451	460	466	497	510	419
	F	88	130	159	181	199	208	233	(202)	244	251	262	260	268	278	190
T-I (0.1)	M	91	149	210	269	319	355	408	(387)	440	439	452	457	471	496	405
	F	88	131	158	184	203	217	238	(221)	247	246	253	250	261	271	183
T-II (1.0)	M	90	145	207	268	318	351	391	(356*)	420	428	442	444	468	488	398
	F	90	137	166	195	216	230	253	(224)	264	265	275	265	280	296	206
T-III (10.0)	M	90	143	205	261	309	344	381	(370)	409	418	437	451	471	496	406
	F	88	129	158	179	204	216	228	(219)	244	248	240	245	263	275	187

* Statistically significant intergroup differences at the 95% ($P < 0.05$) confidence level.

( ) = Body weight scale possibly malfunctioned since it appears that all groups lost weight.

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B. Food Consumption

Mean food consumption data collected during the 90-day test period are summarized in Table III. The average food intake among test animals was similar to that of the controls.

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TABLE III

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Food Consumption Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Food Consumption (g/rat/7 days) Week: 1	2	3	4	5	6	7	8	9	10	11	12	13	90-Day Average Food Consumption (g/rat)
Control (0)	M	123	173	182	200	205	197	214	201	188	198	204	191	236	193
	F	111	130	142	150	189	152	148	164	127	147	132	133	143	144
T-I (0.1)	M	133	170	183	191	182	185	190	182	179	173	178	154	190	176
	F	108	126	121	126	123	127	130	131	135	135	129	108	130	125
T-II (1.0)	M	129	175	188	193	189	188	165	168	178	184	184	160	179	175
	F	121	138	134	142	137	143	140	156	142	144	135	126	141	138
T-III (10.0)	M	138	179	193	206	196	199	204	200	208	220	215	194	216	198
	F	121	136	133	143	142	138	130	128	139	144	148	128	154	137

C. Mortality and Reactions

There were fourteen mortalities noted throughout the study. The following animals died during the investigation:

Group and Dietary Level (%)	Animal Number and Sex	Days on Test	Probable Cause of Death
Control (0)	2-M	64	Unknown
	4-M	21	Unknown
	16-F	63	Unknown
	19-F	84	Found dead after blood collection
	28-F	40	Found dead after blood collection
T-I (0.1)	46-F	84	Found dead after blood collection
T-II (1.0)	77-F	84	Found dead after blood collection
	81-F	84	Found dead after blood collection
T-III (10.0)	109-F	84	Found dead after blood collection
	110-F	84	Found dead after blood collection
	111-F	84	Found dead after blood collection
	112-F	40	Found dead after blood collection
	113-F	40	Found dead after blood collection
	118-F	40	Found dead after blood collection

No untoward behavioral reactions were noted among any of the animals employed in the study.

D. Hematologic Studies

The results of the hematologic studies conducted are presented in Tables IV and V. No outstanding differences between test and control rats were noted with respect to any of the parameters investigated. The random statistically significant findings do not reflect any consistent alterations in the values. The values were well within the normal range for animals of this age and strain.

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TABLE IV

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Hematologic Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Total Leukocyte Count (thousands/mm^3) Day: 40	84	Erythrocyte Count (millions/mm^3) Day: 40	84	Hemoglobin Concentration (g/100 ml) Day: 40	84	Hematocrit Value (%) Day: 40	84
Control (0)	M	12.3	15.4	8.	9.63	15.8	16.5	45.2	50.4
	F	11.4	10.2	8.00	8.89	15.2	15.6	44.3	48.7
T-I (0.1)	M	-	15.9	-	9.77	-	16.3	-	51.6
	F	-	10.0	-	9.05	-	15.6	-	49.2
T-II (1.0)	M	-	13.2	-	9.38	-	15.8	-	49.5
	F	-	6.9*	-	8.27**	-	15.1	-	45.1**
T-III (10.0)	M	10.5	11.0*	7.83	8.92	14.9**	15.7	43.4*	46.5
	F	8.5**	8.4	7.37	8.33*	13.7**	15.2	41.5	45.2**

* Statistically significant intergroup differences at the 95% ($P < 0.05$) confidence level.
** Statistically significant intergroup differences at the 99% ($P < 0.01$) confidence level.
- = No analyses conducted.

TABLE V

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Hematologic Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Differential Leukocyte Count (Number of Cells per Hundred)											
		Lymphocytes Day:		Neutrophils Day:		Monocytes Day:		Eosinophils Day:		Basophils Day:		Bands Day:	
		40	84	40	84	40	84	40	84	40	84	40	84
Control (0)	M	82.6	83.3	15.0	14.6	1.5	1.0	0.4	0.4	0.0	0.0	0.5	0.7
	F	86.5	82.1	11.5	16.1	1.1	0.5	0.4	1.2	0.0	0.0	0.5	0.1
T-I (0.1)	M	-	84.8	-	12.5	-	0.7	-	1.1	-	0.0	-	0.9
	F	-	80.5	-	17.9	-	0.4	-	0.9	-	0.0	-	0.3
T-II (1.0)	M	-	80.5	-	18.6	-	0.3	-	0.3	-	0.0	-	0.3
	F	-	86.0	-	12.3	-	0.6	-	0.9	-	0.0	-	0.2
T-III (10.0)	M	83.0	86.2	14.7	12.7	1.4	0.5	0.4	0.5	0.0	0.0	0.5	0.1
	F	80.5	80.6	17.4	17.9	1.0	0.7	0.5	0.6	0.0	0.0	0.6	0.2

- = No analyses conducted.

E. Clinical Blood Chemistry Studies

The results of the clinical chemistry studies conducted at 40 and 84 days of testing are summarized in Tables VI and VII. Slight increases were noted in the serum alkaline phosphatase activity (SAP) among males (not females) fed 10.0% FireMaster® 680 at 40 and 84 days of testing. Evaluation of lower test levels at 84 days revealed values which were similar to controls. No other biologically significant changes were noted.

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TABLE VI

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Clinical Blood Chemistry Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Serum Alkaline Phosphatase Activity (International Units/L) Day: 40	84	Serum Glutamic Pyruvic Transaminase Activity (International Units/L) Day: 40	84
Control (0)	M	98	79	19	20
	F	48	31	15	16
T-I (0.1)	M	-	83	-	22
	F	-	33	-	17
T-II (1.0)	M	-	80	-	18
	F	-	32	-	20
T-III (10.0)	M	135**	102	18	21
	F	49	26	14	20

** Statistically significant intergroup differences at the 99% ($P < 0.01$) confidence level.
- = No analyses conducted.

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TABLE VII

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Clinical Blood Chemistry Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Blood Urea Nitrogen Concentration (mg/100 ml) Day: 40	84	Fasting Blood Glucose Concentration (mg/100 ml) Day: 40	84
Control (0)	M	14	15	132	142
	F	15	14	129	143
T-I (0.1)	M	-	17	-	130
	F	-	17	-	129
T-II (1.0)	M	-	18	-	127
	F	-	16	-	131
T-III (10.0)	M	15	17	111**	121
	F	14	16	133	117**

** Statistically significant intergroup differences at the 99% ($P<0.01$) confidence level.
- = No analyses conducted.

F. Urinalyses

The results of the urinalyses conducted at 40 and 84 days are presented in Table VIII. No significant differences between the urine of test rats and control rats were observed.

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TABLE VIII

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Urinalyses Data

Summary of Mean Values

Group and Dietary Level (%)	Sex	Glucose Day: 40	Glucose Day: 84	Albumin Day: 40	Albumin Day: 84	pH Day: 40	pH Day: 84	Specific Gravity Day: 40	Specific Gravity Day: 84	Microscopic Elements* Day: 40	Microscopic Elements* Day: 84
Control (0)	M	n	n	n	n	7	7	1.015	1.025	t	t
	F	n	n	n	n	7	7	1.022	1.017	+1	n
T-I (0.1)	M	-	n	-	n	-	7	-	1.024	-	t
	F	-	n	-	n	-	7	-	1.015	-	n
T-II (1.0)	M	-	n	-	n	-	7	-	1.020	-	t
	F	-	n	-	n	-	7	-	1.013	-	n
T-III (10.0)	M	n	n	n	t	7	7	1.014	1.012	+1	t
	F	n	n	n	n	7	6	1.013	1.014	t	t

Key: n = negative or normal
t = minimal or trace
+1 = slight amounts
+2 = moderate amounts
+3 = large amounts
* Crystals

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G. Pathologic Studies

1. Gross Pathologic Findings

The findings noted upon gross pathologic examination were similar for both test and control animals. The individual findings are presented below:

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Group and Dietary Level (%)	Animal Number and Sex	Days on Test	Gross Observations
Control (0)	16-F	62	Liver - nodule in 1 lobe (1 cm. in diameter)
	26-F	106	Lung - dark red discoloration of all lobes
	28-F	40	Lung - abscesses in all lobes
T-I (0.1)	32-M	106	Kidneys - unilateral pelvic dilatation and filled with urine
	44-M	106	Testes - small and cyanotic (unilateral)
	48-F	106	Lung - two lobes adhered to thorax
	49-F	106	Lung - diffuse red discoloration of all lobes
T-II (1.0)	61-M	106	Lung - numerous white foci in all lobes
	70-M	106	Kidneys - unilateral pelvic dilatation
	75-M	106	Kidneys - cyst - unilateral
T-III (10.0)	110-F	84	Lung - consolidation of all lobes
	118-F	40	Lung - diffuse dark discoloration of all lobes

No treatment-related gross pathologic findings were evident.

2. Organ Weights, Organ to Body Weight Ratios, and Organ to Brain Weight Ratios

The results of the statistical analyses conducted on absolute organ weights, organ to body weight ratios, and organ to brain weight ratios are summarized in Tables IX through XIV. The final body weights used to calculate the organ to body weight ratios are presented in Table XV. No treatment-related alterations were noted in the organ weight data among any of the levels tested.

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TABLE IX

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - BRAIN

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	2.175	1.784	0.4171	0.6204	1.0000	1.0000
I	0.1	2.206	1.777	0.4270	0.6168	1.0000	1.0000
II	1.0	2.192	1.799	0.4396	0.5883	1.0000	1.0000
III	10.0	2.131	1.796	0.4099	0.6262	1.0000	1.0000

(a) STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

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Industrial BIO-TEST Laboratories, Inc.

TABLE X

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - BOTH GONADS

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	3.425	0.106	0.6577	0.0368	1.5752	0.0596
T-I	0.1	3.150	0.090	0.6091	0.0314	1.4275	0.0506
T-II	1.0	3.447	0.089	0.6930	0.0292	1.5717	0.0498
T-III	10.0	3.397	0.094	0.6532	0.0330	1.5997	0.0527

NO STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

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TABLE XI

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - HEART

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	1.634	1.135	0.3122	0.3933	0.7519	0.6364
T-I	0.1	1.642	1.119	0.3166	0.3878	0.7443	0.6295
T-II	1.0	1.662	1.147	0.3330	0.3739	0.7583	0.6374
T-III	10.0	1.561	1.149	0.2992	0.3996	0.7350	0.6395

NO STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

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TABLE XII

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - BOTH KIDNEYS

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	3.721	2.175	0.7077	0.7542	1.7115	1.2200
T-I	0.1	3.689	2.099	0.7130	0.7246	1.6733	1.1813
T-II	1.0	3.953	2.324	0.7877*	0.7561	1.8033	1.2933
T-III	10.0	3.759	2.438*	0.7206	0.8479	1.7701	1.3582

* STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES AT THE 95% (P<.05) CONFIDENCE LEVEL.

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TABLE XIII

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - LIVER

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	18.028	9.850	3.4236	3.3777	8.2965	5.5228
T-I	0.1	18.097	9.618	3.4957	3.3157	8.2032	5.4130
T-II	1.0	17.247	10.402	3.4205	3.3682	7.8699	5.7822
T-III	10.0	17.905	10.834	3.4261	3.7779	8.4393	6.0467

' STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

TABLE XIV

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

ORGAN WEIGHT AND RATIO DATA

SUMMARY OF MEAN VALUES

ORGAN - SPLEEN

GROUP	DIETARY LEVEL PERCENT	ORGAN WEIGHT (G)		ORGAN/BODY WEIGHT RATIO (G/100 G)		ORGAN/BRAIN WEIGHT RATIO (G/G)	
		MALES	FEMALES	MALES	FEMALES	MALES	FEMALES
CONTROL	0	0.799	0.525	0.1532	0.1821	0.3677	0.2945
T-I	0.1	0.850	0.509	0.1636	0.1750	0.3859	0.2867
T-II	1.0	0.854	0.526	0.1745	0.1712	0.3907	0.2930
T-III	10.0	0.858	0.556	0.1647	0.1933	0.4032	0.3095

NO STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

TABLE XV

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE

FINAL BODY WEIGHT DATA

SUMMARY OF MEAN VALUES

GROUP	DIETARY LEVEL PERCENT	BODY WEIGHT (G) MALES	FEMALES
CONTROL	0	526.000	291.091
T-I	0.1	518.467	290.500
T-II	1.0	506.000	308.077
T-III	10.0	522.600	288.000

NO STATISTICALLY SIGNIFICANT INTERGROUP DIFFERENCES FOUND.

3. Histopathologic Findings

Treatment-related histopathologic findings among animals fed 10% FireMaster® 680 are presented in Table XVI. Incidental, non-treatment-related findings among all test groups are presented in Tables XVII and XVIII. The pathologist's statement is presented on the following page.

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0443

IBT No. 8532-08925
Michigan Chemical Corporation

I have completed a histopathological examination of a series of tissues from control and test animals of Group III (10.0%) of Study Number 8532-08925. In addition, sections of liver from test animals of Groups T-I (0.1%) and T-II (1.0%) were also examined. There were treatment-related hepatic changes present among most of the test animals of Group T-III which are tabulated, by animal, in Table XVI. The lesion consisted of either focal or multifocal enlargement (hypertrophy) of hepatocytes located within the centrilobular to midzonal regions of affected liver lobules. The severity of the lesion was graded as minimal. The incidence of this lesion was higher among male test animals. No treatment-related changes were evident among animals fed either 0.1 or 1.0% FireMaster ® 680. The other changes recorded for liver and other tissues, were lesions of naturally occurring diseases and they were present, in most instances, among both control and test animals. Those findings are summarized with the treatment-related changes in Tables XVII and XVIII.

MSF 0319

Reynaldo J. Arceo, M.D.
Staff Pathologist

Reviewed and Approved:

Donovan E. Gordon, D.V.M., Ph.D.
Diplomate, American College of
Veterinary Pathologists

TABLE XVI

TEST MATERIAL: FireMaster ® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Animal Group and Dietary Level (%)	Individual Treatment-Related Histopathologic Findings: Animal Number and Sex	Hypertrophy of Hepatocytes in Centrilobular to Midzonal Region of Lobules: Focal	Multifocal	Diffuse
Control (0.0)	1-M			
	3-M			
	5-M			
	6-M			
	7-M			
	8-M			
	9-M			
	10-M			
	11-M			
	12-M			
	17-F			
	18-F			
	20-F			
	21-F			
	22-F			
	23-F			
	24-F			
	25-F			
	26-F			
	27-F			

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TABLE XVI continued

TEST MATERIAL: FireMaster ® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Animan Group and Dietary Level (%)	Animal Number and Sex	Individual Treatment-Related Histopathologic Findings: Hypertrophy of Hepatocytes in Centrilobular to Midzonal Region of Lobules		
		Focal	Multifocal	Diffuse
T-I (0.1)	31-M			
	32-M			
	33-M			
	34-M			
	35-M			
	36-M			
	37-M			
	38-M			
	39-M			
	40-M			
	47-F			
	48-F			
	49-F			
	50-F			
	51-F			
	52-F			
	53-F			
	54-F			
	55-F			
	56-F			

MRE 0321

TABLE XVI, continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Individual Treatment-Related Histopathologic Findings

Animal Group and Dietary Level (%)	Animal Number and Sex	Hypertrophy of Hepatocytes in Centrilobular to Midzonal Region of Lobules: Focal	Multifocal	Diffuse
T-II (1.0)	61-M			
	62-M			
	63-M			
	64-M			
	65-M			
	66-M			
	67-M			
	68-M			
	69-M			
	70-M			
	76-F			
	78-F			
	79-F			
	80-F			
	82-F			
	83-F			
	84-F			
	85-F			
	86-F			
	87-F			

MR 0322

TABLE XVI continued

TEST MATERIAL: FireMaster ® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Animal Group and Dietary Level (%)	Animal Number and Sex	Individual Treatment-Related Histopathologic Findings: Hypertrophy of Hepatocytes in Centrilobular to Midzonal Region of Lobules		
		Focal	Multifocal	Diffuse
T-III (10.0)	91-M			
	92-M			
	93-M	+	+	
	94-M	+		
	95-M			
	96-M		+	
	97-M	+	+	
	98-M	+		
	99-M	+		
	100-M	+		
	106-F		+	
	107-F			
	108-F	+		
	109-F*	+		
	114-F			
	115-F	+		
	116-F			
	117-F			
	119-F	+	+	
	120-F	+		

* Animal found dead after blood collection.

+ = Minimal or trace in severity

++ = Mild in severity

+++ = Moderate in severity

++++ = Marked in severity

MRE 0323

TABLE XVII

TEST MATERIAL: FireMaster ® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Summary of Histopathologic Findings - Males

System / Organ or Tissue	Group and Dietary Level (%): Number Examined: / Histopathologic Findings	Control (0.0) 10 Incidence	Control (0.0) 10 Average Grade	T-I* (0.1) 10 Incidence	T-I* (0.1) 10 Average Grade	T-II* (1.0) 10 Incidence	T-II* (1.0) 10 Average Grade	T-III (10.0) 10 Incidence	T-III (10.0) 10 Average Grade
Circulatory									
Heart	Focus of/or focal chronic myocarditis	5	1.0	-	-	-	-	3	1.2
Respiratory									
Trachea	Chronic tracheitis	9	2.5	-	-	-	-	10	2.0
Lung	Chronic murine pneumonia	9	2.2	-	-	-	-	10	1.7
	Acute focal bronchopneumonia	2	1.0	-	-	-	-	0	-
	Multifocal bronchiectatic abscesses in one lobe	1	P	-	-	-	-	0	-
	Focal aggregates of alveolar macrophages	6	1.7	-	-	-	-	0	-
	Focal alveolar hemorrhage (agonal)	1	2.0	-	-	-	-	1	1.4
	Focal congestion (agonal)	2	2.8	-	-	-	-	3	1.5
	Terminally inhaled blood (agonal)	0	-	-	-	-	-	1	1.0
Reticuloendothelial									
Lymph nodes (cervical)	Focal sinusoidal ectasia	0	-	-	-	-	-	0	-
Spleen	Increased extramedullary hematopoiesis	1	1.0	-	-	-	-	1	1.0
	Diffuse sinusoidal congestion	2	2.5	-	-	-	-	0	-
Liver	Focal extramedullary hematopoiesis (portal)	3	1.0	4	1.0	4	1.0	3	2.0
	Focal extramedullary hematopoiesis (portal and sinusoidal)	6	1.2	1	1.0	1	1.0	6	1.1
	Focus of necrotic hepatitis	1	1.0	1	1.0	1	1.0	2	1.0
	Focal portal lymphoid infiltrations	2	1.0	0	-	0	-	4	1.0
	Focal sinusoidal lymphoid infiltrations	1	1.0	1	1.0	2	1.0	5	1.0
	Focal bile duct proliferation	1	1.0	0	-	0	-	0	-
	Focal centrilobular to midzonal hypertrophy of hepatocytes	0	-	0	-	0	-	6	1.0
	Multifocal centrilobular to midzonal hypertrophy of hepatocytes	0	-	0	-	0	-	4	1.0

* Liver examined only.

MAE 0324

TABLE XVII continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Summary of Histopathologic Findings - Males

System / Organ or Tissue	Group and Dietary Level (%) / Number Examined / Histopathologic Findings	Control (0.0) 10		T-I * (0.1) 10		T-II* (1.0) 10		T-III (10.0) 10	
		Incidence	Average Grade	Incidence	Average Grade	Incidence	Average Grade	Incidence	Average Grade
Endocrine									
Adrenal glands	Hypervolemia - unilateral	1	1.0	-	-	-	-	2	1.0
	Hypervolemia - bilateral	1	1.0	-	-	-	-	3	1.0
	Lipomatous degeneration of cortex - unilateral	1	1.0	-	-	-	-	1	1.0
	Lipomatous degeneration of cortex - bilateral	2	1.5	-	-	-	-	0	-
Pituitary gland	Focal cytoplasmic vacuolation of basophils	3	1.0	-	-	-	-	6	1.0
Pancreas	Focal interstitial lymphoid infiltrations	2	1.0	-	-	-	-	2	1.0
	Focal atrophy of acinar cells	1	1.0	-	-	-	-	0	-
Digestive									
Salivary glands (parotid)									
Stomach	Focal interstitial lymphoid infiltrations	1	1.0	-	-	-	-	0	-
	Solitary submucosal cyst with keratinized debri in glandular portion	0	-	-	-	-	-	1	P
Colon	Parasites in lumen (Nematodiasis)	1	P	-	-	-	-	1	P
Urinary									
Kidneys	Focal interstitial lymphoid infiltrations - unilateral	5	1.0	-	-	-	-	5	1.0
	Focal interstitial lymphoid infiltrations - bilateral	3	1.0	-	-	-	-	2	1.0
	Focal proteinaceous tubular casts - bilateral	1	1.0	-	-	-	-	0	-
	Focus of tubular nephrosis - unilateral	1	1.0	-	-	-	-	2	1.0
	Focal tubular nephrosis - bilateral	1	1.0	-	-	-	-	1	1.0
Urinary bladder	Solitary medullary cyst - unilateral	1	1.0	-	-	-	-	0	-
	Proteinaceous plug in lumen	4	P	-	-	-	-	6	P

* Liver examined only.

Industrial BIO-TEST Laboratories, Inc.

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TABLE XVII continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Summary of Histopathologic Findings - Males

System / Organ or Tissue	Histopathologic Findings	Group and Dietary Level (%): Number Examined: Control (0.0) 10		T-II* (0.1) 10		T-II* (1.0) 10		T-III (10.0) 10	
		Incidence	Average Grade	Incidence	Average Grade	Incidence	Average Grade	Incidence	Average Grade
Reproductive									
Testes	Focus of subcapsular testicular degeneration - unilateral	0	-	-	-	-	-	1	1.0
	Focal testicular degeneration - unilateral	0	-	-	-	-	-	1	1.0
	Focal mineralization of some degenerate tubules - unilateral	0	-	-	-	-	-	1	1.0
Prostate	Focal interstitial lymphoid infiltrations	1	1.0	-	-	-	-	0	-
	Acute focal prostatitis	0	-	-	-	-	-	1	1.0
Prostatic urethra	Proteinaceous plug in lumen	1	p	-	-	-	-	0	-
Integumentary									
Skin	Focus of/or focal epidermal acanthosis	1	1.0	-	-	-	-	3	1.0

* Liver examined only.

Grading System:
1.0 = Trace or minimal in severity
2.0 = Mild in severity
3.0 = Moderate in severity
4.0 = Marked in severity
5.0 = Extreme in severity
p = Present, no grade

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TABLE XVIII

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Summary of Histopathologic Findings - Females

System / Organ or Tissue	Histopathologic Findings	Control (0.0) 10 Incidence	Control (0.0) 10 Average Grade	T-I* (0.1) 10 Incidence	T-I* (0.1) 10 Average Grade	T-II* (1.0) 10 Incidence	T-II* (1.0) 10 Average Grade	T-III (10.0) 10** Incidence	T-III (10.0) 10** Average Grade
Circulatory									
Heart	Focus of chronic myocarditis	0	-	-	-	-	-	1	1.0
Respiratory									
Trachea	Chronic tracheitis	10	1.6	-	-	-	-	9	1.8
	Inflammatory exudate in lumen	0	-	-	-	-	-	1	P
Lung	Chronic murine pneumonia	10	1.5	-	-	-	-	10	1.6
	Acute multifocal bronchopneumonia	0	-	-	-	-	-	1	3.0
	Focal aggregates of alveolar macrophages	6	1.2	-	-	-	-	8	1.3
	Focal congestion (agonal)	1	2.0	-	-	-	-	0	-
	Diffuse congestion (agonal)	2	2.3	-	-	-	-	1	3.0
	Diffuse edema (agonal)	0	-	-	-	-	-	1	3.0
	Terminally inhaled blood (agonal)	1	P	-	-	-	-	0	-
Reticuloendothelial									
Spleen	Diffuse sinusoidal congestion	0	-	-	-	-	-	1	2.0
	Increased amount of hemosiderin pigment	0	-	-	-	-	-	1	1.0
Liver	Focal extramedullary hematopoiesis (portal)	5	1.0	3	1.0	2	1.0	2	1.0
	Focal extramedullary hematopoiesis (sinusoidal)	0	-	0	-	0	-	1	1.0
	Focal extramedullary hematopoiesis (portal and sinusoidal)	1	1.0	1	1.5	0	-	4	1.1
	Focus of necrotic hepatitis	0	-	1	1.0	0	-	0	-
	Focal sinusoidal lymphoid infiltrations	2	1.0	1	1.0	0	-	2	1.0
	Focal portal lymphoid infiltrations	3	1.0	0	-	5	1.0	2	1.3
	Centrilobular cytoplasmic vacuolation - lipid	1	1.0	0	-	0	-	0	-
	Diffuse sinusoidal congestion	0	-	0	-	0	-	1	2.5
	Focal centrilobular to midzonal hypertrophy of hepatocytes	0	-	0	-	6	-	5	1.0
	Multifocal centrilobular to midzonal hypertrophy of hepatocytes	0	-	0	-	0	-	1	1.0
Endocrine									
Thyroid glands	Remnant of ultimobranchial rest - unilateral	2	P	-	-	-	-	2	P
Adrenal glands	Hypervolemia - unilateral	0	-	-	-	-	-	1	1.0
	Hypervolemia - bilateral	0	-	-	-	-	-	2	1.8
Pituitary gland	Focal hyperplasia	0	-	-	-	-	-	2	1.0
Pancreas	Focal interstitial lymphoid infiltrations	1	1.0	-	-	-	-	3	1.0

* Liver examined only.

** One animal was found dead after blood collection.

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TABLE XVIII continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Final Sacrifice

Summary of Histopathologic Findings - Females

System / Organ or Tissue	Histopathologic Findings	Group and Dietary Level (%): Number Examined: Control (0.0) 10 Incidence	Control (0.0) 10 Average Grade	T-I* (0.1) 10 Incidence	T-I* (0.1) 10 Average Grade	T-II* (1.0) 10 Incidence	T-II* (1.0) 10 Average Grade	T-III (10.0) 10** Incidence	T-III (10.0) 10** Average Grade
Digestive									
Stomach	Subacute focal gastritis in forestomach	0	-	-	-	-	-	1	1.0
Caecum	Parasites in lumen (Nematodiasis)	1	P	-	-	-	-	0	-
Colon	Parasites in lumen (Nematodiasis)	3	P	-	-	-	-	1	P
Urinary									
Kidneys	Focal interstitial lymphoid infiltrations - unilateral	3	1.0	-	-	-	-	4	1.0
	Focal interstitial lymphoid infiltrations - bilateral	2	1.5	-	-	-	-	3	1.5
	Focus of tubular nephrosis - unilateral	1	1.0	-	-	-	-	0	-
	Focus of/or focal tubular nephrosis - bilateral	3	1.0	-	-	-	-	1	1.0
	Focal mineralised microconcretions in tubules - unilateral	2	1.0	-	-	-	-	1	1.0
	Focal mineralised microconcretions in tubules - bilateral	1	1.0	-	-	-	-	0	-
	Chronic nephritis - bilateral	1	1.5	-	-	-	-	0	-
Reproductive									
Ovaries	Cystic corpora lutea - unilateral	3	1.0	-	-	-	-	2	1.3
	Cystic corpora lutea - bilateral	1	1.5	-	-	-	-	0	-
Uterus	Hydrometra (dilatation of lumen of uterine horns)	0	-	-	-	-	-	3	1.5
Integumentary									
Skin	Focus of epidermal acanthosis	1	1.0	-	-	-	-	0	-

* Liver examined only.

** One animal was found dead after blood collection.

Grading System:

1.0 = Trace or minimal in severity
2.0 = Mild in severity
3.0 = Moderate in severity
4.0 = Marked in severity
5.0 = Extreme in severity
P = Present, no grade

MF 0328

88-7800184 8EHQ-0678-0184 (B6)

Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

B6

Supplemental data for a previous 0184 submission

PAGE 0330

REPORT TO

MICHIGAN CHEMICAL CORPORATION

90-DAY SUBACUTE ORAL TOXICITY STUDY
WITH
FIREMASTER® 680

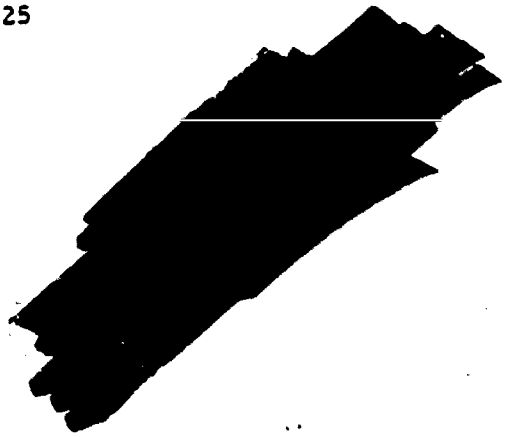
IN ALBINO RATS

P.O. NO. 21982-A

MARCH 10, 1977

IBT NO. 8532-08925

[redacted]



Document declassified on 8-22-78

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Industrial BIO-TEST Laboratories, Inc.
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

March 10, 1977

PAGE 0331

Dr. A. Fred Kerst
Research & Development
Technical Center
1975 Green Road
Ann Arbor, Michigan 48105

Dear Dr. Kerst:

Re: IBT No. 8532-08925 - 90-Day Subacute Oral Toxicity Study with FireMaster® 680 in Albino Rats - P.O. No. 21981-A

We are enclosing herewith our Addendum Report of Individual Data prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC/fd

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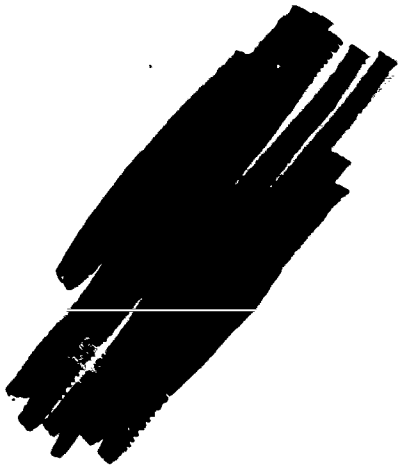
V. Addendum Report - Individual Data	1
A. Body Weights	10
B. Food Consumption	13
C. Hematology	19
D. Clinical Blood Chemistry	24
E. Urinalyses	27
F. Organ Weights and Ratios	

MRD 0332



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A. Body Weights

The individual body weight data are presented in Tables I and II.

PAGE 0333

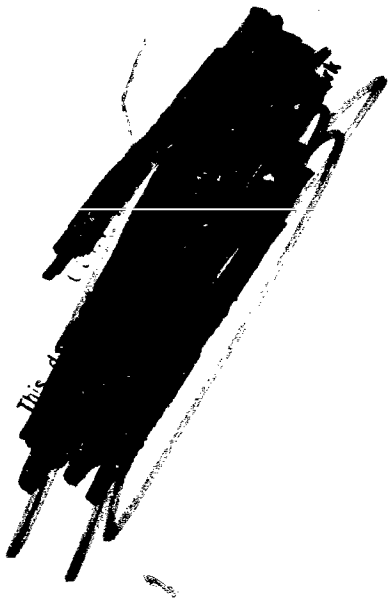

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TABLE I

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

MALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: C (0 PERCENT)

ANIMAL NUMBER	DATE (1976): DAYS ON TEST: WEEK:	4/30 0 0	5/07 7 1	5/14 14 2	5/21 21 3	5/28 28 4	6/04 35 5	6/14 45 6	6/18 49 7	6/25 56 8	7/02 63 9	7/09 70 10	7/16 77 11	7/26 87 12	7/29 90 13	TOTAL WEIGHT CHANGE
1		89	149	208	264	316	344	368	387	400	398	411	436	462	466	377
2		90	148	213	263	305	349	397	401	428	***	*****	***	***	***	***
3		99	165	232	298	351	395	458	486	512	524	541	513	576	591	492
4		77	127	183	227	***	***	***	***	***	***	***	***	***	***	***
5		96	153	216	273	333	376	442	453	468	477	485	482	499	522	426
6		108	172	239	309	358	398	449	454	490	515	539	543	561	569	461
7		82	139	200	239	272	302	339	347	378	384	377	351	414	428	346
8		94	147	218	274	329	358	392	361	439	437	438	427	431	425	331
9		89	151	213	279	326	359	405	402	439	436	456	451	509	531	442
10		96	151	221	278	334	370	422	407	461	477	470	483	511	532	436
11		77	139	202	262	317	352	406	410	459	461	473	495	511	530	453
12		99	159	215	263	302	331	364	362	413	430	439	461	481	492	393
13		94	151	217	278	327	366	400	388	436	452	461	477	514	514	420
14		90	158	225	287	337	369	403	412	447	450	473	492	527	534	444
15		82	134	195	250	294	322	366	379	413	421	413	451	467	492	410

**** ANIMAL DIED DURING TESTING.

[redacted]

MGF 0334

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TABLE I CONTINUED

TEST MATERIAL - FIREMASTER 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

MALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-I (0.1 PERCENT)

ANIMAL NUMBER	DATE (1976): / DAYS ON TEST: / WEEK:	4/30 / 0 / 0	5/07 / 7 / 1	5/14 / 14 / 2	5/21 / 21 / 3	5/28 / 28 / 4	6/04 / 35 / 5	6/14 / 45 / 6	6/18 / 49 / 7	6/25 / 56 / 8	7/02 / 63 / 9	7/09 / 70 / 10	7/16 / 77 / 11	7/26 / 87 / 12	7/29 / 90 / 13	TOTAL WEIGHT CHANGE
31		82	147	218	277	333	367	422	419	458	472	474	480	504	519	437
32		108	167	232	290	342	365	424	341	466	477	507	501	466	503	395
33		90	153	214	277	333	373	424	411	401	355	292	278	379	414	324
34		94	158	211	273	321	355	402	411	439	421	446	430	456	473	379
35		99	151	197	246	288	309	351	330	392	390	413	427	401	453	354
36		87	140	198	257	297	318	362	358	390	357	402	367	430	427	340
37		96	150	224	287	338	381	464	419	506	494	516	552	518	566	470
38		85	142	202	264	311	349	382	362	423	425	431	430	436	474	389
39		97	153	205	255	306	357	423	388	428	451	475	441	482	524	427
40		77	130	193	255	299	341	390	356	429	448	462	493	501	527	450
41		95	155	216	278	346	387	453	409	493	512	526	550	554	567	472
42		92	151	217	274	326	366	420	421	444	442	449	481	466	465	373
43		89	144	205	268	314	344	396	402	422	426	438	460	477	483	394
44		90	151	207	270	319	352	395	376	441	448	466	482	496	509	419
45		80	139	209	268	317	360	412	396	461	474	488	481	498	543	463

[redacted]

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Industrial BIO-TEST Laboratories, Inc.

TABLE I CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

MALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-II (1.0 PERCENT)

ANIMAL NUMBER	DATE (1976):	4/30	5/07	5/14	5/21	5/28	6/04	6/14	6/18	6/25	7/02	7/09	7/16	7/26	7/29	TOTAL WEIGHT CHANGE
	DAYS ON TEST:	0	7	14	21	28	35	45	49	56	63	70	77	87	90	
	WEEK:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
61		80	138	201	259	302	334	353	338	340	323	320	294	314	329	249
62		96	155	217	284	340	380	411	392	430	437	456	442	477	505	409
63		89	145	211	272	319	355	397	368	424	429	422	428	487	491	402
64		105	170	236	306	353	383	408	431	458	460	496	458	499	527	422
65		95	151	213	271	310	332	369	303	409	394	420	423	423	440	345
66		94	150	211	268	316	350	403	303	446	461	486	505	507	524	430
67		99	160	227	292	350	390	453	430	487	507	503	542	544	548	449
68		90	147	216	286	348	389	438	406	459	490	501	496	519	542	452
69		96	155	217	279	330	346	354	333	388	394	420	415	427	466	370
70		90	139	199	260	312	366	422	380	436	446	438	470	494	515	425
71		85	140	195	246	294	317	361	312	387	386	402	414	438	443	358
72		87	132	186	245	305	333	396	350	419	423	460	471	495	502	415
73		89	147	211	261	304	333	356	290	394	392	413	415	463	471	382
74		80	125	183	243	289	317	359	356	397	415	431	425	466	494	414
75		77	128	187	245	296	342	391	348	423	462	461	469	472	521	444

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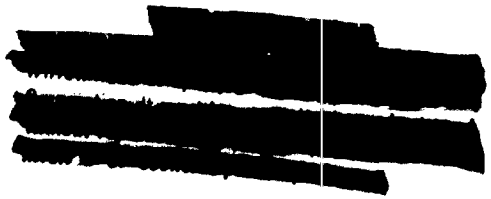

TABLE I CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

MALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-III (10.0 PERCENT)

ANIMAL NUMBER	DATE (1976): / DAYS ON TEST: / WEEK:	4/30 / 0 / 0	5/07 / 7 / 1	5/14 / 14 / 2	5/21 / 21 / 3	5/28 / 28 / 4	6/04 / 35 / 5	6/14 / 45 / 6	6/18 / 49 / 7	6/25 / 56 / 8	7/02 / 63 / 9	7/09 / 70 / 10	7/16 / 77 / 11	7/26 / 87 / 12	7/29 / 90 / 13	TOTAL WEIGHT CHANGE
91		95	158	221	277	331	368	426	429	465	461	488	488	510	542	447
92		87	149	206	266	310	344	398	416	427	459	474	492	468	508	421
93		100	149	213	279	325	369	413	452	426	452	498	521	543	556	456
94		90	148	207	254	298	321	365	327	398	335	420	438	411	485	395
95		96	157	215	269	320	340	370	369	380	391	421	414	454	490	394
96		85	144	205	267	318	354	391	363	447	455	478	483	485	512	427
97		94	146	215	264	293	320	345	335	381	415	364	412	418	448	354
98		80	133	196	256	311	354	378	366	408	399	444	465	483	524	444
99		100	154	203	265	308	340	368	354	401	407	376	410	419	443	343
100		89	137	200	246	298	334	375	346	404	403	435	454	465	467	378
101		90	121	188	244	295	330	366	312	405	378	429	408	464	480	390
102		96	148	212	265	316	350	372	341	394	401	423	456	482	498	402
103		80	130	190	247	301	345	381	389	409	430	424	403	501	698*	-
104		77	135	196	251	295	324	359	361	398	418	433	427	477	472	395
105		89	141	208	262	316	369	401	389	453	465	451	490	492	521	432

* ERRONEOUS WEIGHT OMITTED FROM THE MEAN.

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Industrial BIO-TEST Laboratories, Inc.

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TABLE II

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FEMALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: C (0 PERCENT)

ANIMAL NUMBER	DATE (1976):	4/30	5/07	5/14	5/21	5/28	6/04	6/14	6/18	6/25	7/02	7/09	7/16	7/26	7/29	TOTAL WEIGHT CHANGE
	DAYS ON TEST:	0	7	14	21	28	35	45	49	56	63	70	77	87	90	
	WEEK:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
16		83	115	134	156	146	126	120	108	93	***	***	***	***	***	***
17		90	132	162	189	207	218	240	226	247	261	255	242	254	259	169
18		95	130	169	191	217	227	262	219	271	259	283	281	298	299	204
19		87	134	166	197	217	236	269	246	287	287	281	291	***	***	***
20		93	143	177	205	237	258	299	257	311	312	320	346	330	334	241
21		103	147	176	213	248	262	267	240	277	254	288	276	289	304	201
22		86	129	153	178	193	201	212	163	228	223	235	219	239	246	160
23		77	119	153	178	199	195	211	164	231	230	231	240	245	247	170
24		93	127	150	179	193	217	235	198	248	227	254	239	246	278	185
25		77	115	139	157	166	175	186	145	201	198	210	212	202	204	127
26		83	122	153	169	191	200	213	190	232	219	236	227	248	258	175
27		95	140	172	215	244	263	278	221	282	293	289	299	309	325	230
28		86	122	148	105	103	103	***	***	***	***	***	***	***	***	***
29		90	134	170	204	231	243	254	254	283	285	290	279	306	321	231
30		87	134	158	183	196	198	214	200	228	215	235	235	250	260	173

*** ANIMAL DIED DURING TESTING.

Industrial BIO-TEST Laboratories, Inc.

BTC 0338

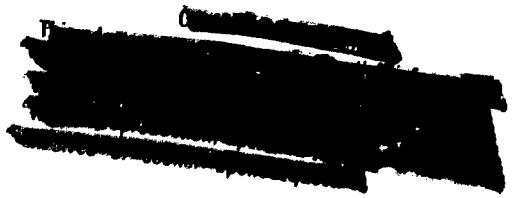

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TABLE II CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FEMALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-I (0.1 PERCENT)

ANIMAL NUMBER	DATE (1976): / DAYS ON TEST: / WEEK:	4/30 / 0 / 0	5/07 / 7 / 1	5/14 / 14 / 2	5/21 / 21 / 3	5/28 / 28 / 4	6/04 / 35 / 5	6/14 / 45 / 6	6/18 / 49 / 7	6/25 / 56 / 8	7/02 / 63 / 9	7/09 / 70 / 10	7/16 / 77 / 11	7/26 / 87 / 12	7/29 / 90 / 13	TOTAL WEIGHT CHANGE
46		77	110	131	145	157	171	164	185	184	186	193	184	***	***	***
47		90	126	149	168	190	190	209	203	220	221	232	188	223	242	152
48		87	142	176	203	235	250	267	263	288	300	293	252	301	294	207
49		100	134	158	176	198	205	226	221	225	234	250	212	239	253	153
50		87	121	148	172	184	205	225	223	224	241	261	236	247	259	172
51		86	129	149	171	190	207	211	210	202	207	213	271	213	238	152
52		93	128	148	173	186	195	213	204	228	226	223	205	230	230	137
53		95	139	168	198	217	234	245	215	250	250	253	261	272	279	184
54		86	126	155	190	214	236	263	232	270	271	270	294	285	288	202
55		84	127	149	171	188	205	229	222	242	231	253	231	241	272	188
56		93	137	164	183	206	221	245	198	252	254	262	261	269	283	190
57		83	132	164	193	207	217	248	247	272	259	268	255	268	276	193
58		98	156	192	226	254	261	291	230	302	302	308	322	324	328	230
59		81	130	149	177	190	209	232	230	248	214	246	260	259	267	186
60		77	132	171	207	236	252	279	233	295	290	276	311	281	286	209

*** ANIMAL DIED DURING TESTING.

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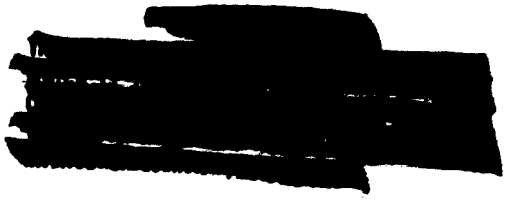

Industrial BIO-TEST Laboratories, Inc.

TABLE II CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FEMALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-II (1.0 PERCENT)

ANIMAL NUMBER	DATE (1976):	4/30	5/07	5/14	5/21	5/28	6/04	6/14	6/18	6/25	7/02	7/09	7/16	7/26	7/29	TOTAL WEIGHT CHANGE
	DAYS ON TEST:	0	7	14	21	28	35	45	49	56	63	70	77	87	90	
	WEEK:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
76		86	135	161	184	218	222	248	251	266	276	260	276	302	302	216
77		84	131	163	193	215	228	251	222	273	280	287	263	***	***	***
78		98	150	183	217	243	266	294	238	286	288	315	310	322	343	245
79		81	121	151	172	193	206	226	205	236	240	245	178	247	260	179
80		90	143	172	206	222	235	255	238	257	271	266	262	273	294	204
81		87	140	172	206	235	233	262	251	290	290	302	309	***	***	***
82		93	131	166	199	222	238	254	188	270	270	273	244	297	296	203
83		84	127	152	173	184	201	217	196	216	223	232	236	237	239	155
84		90	135	168	193	214	232	255	215	266	257	282	249	275	289	199
85		93	146	171	201	209	225	239	200	249	232	250	265	200	278	185
86		98	139	166	192	209	223	250	226	258	251	271	275	293	297	199
87		93	136	162	186	199	216	237	229	242	245	249	232	252	280	187
88		95	140	167	198	217	230	256	219	279	278	273	300	294	309	214
89		86	141	171	208	223	243	271	215	280	276	308	296	315	326	240
90		87	134	162	199	231	252	276	260	291	304	315	285	330	339	252

*** ANIMAL DIED DURING TESTING.

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TABLE II CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FEMALES

INDIVIDUAL BODY WEIGHT DATA (G)

GROUP: T-III (10.0 PERCENT)

ANIMAL NUMBER	DATE (1976):	4/30	5/07	5/14	5/21	5/28	6/04	6/14	6/18	6/25	7/02	7/09	7/16	7/26	7/29	TOTAL WEIGHT CHANGE
	DAYS ON TEST:	0	7	14	21	28	35	45	49	56	63	70	77	87	90	
	WEEK:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
106		86	128	158	182	203	221	239	256	256	256	264	230	261	282	196
107		81	128	154	175	203	220	225	204	231	235	212	218	254	238	157
108		93	129	151	174	198	208	221	233	240	233	237	247	251	254	161
109		84	122	151	172	199	213	234	219	227	233	211	219	***	***	***
110		90	129	147	162	187	198	195	201	196	210	224	234	***	***	***
111		86	120	145	166	199	217	226	205	256	254	224	243	***	***	***
112		98	144	175	191	214	230	***	***	***	***	***	***	***	***	***
113		77	120	148	169	188	195	***	***	***	***	***	***	***	***	***
114		87	130	163	182	207	218	234	239	263	265	253	279	278	298	211
115		81	123	155	175	202	209	226	214	233	245	245	245	248	251	170
116		93	123	152	179	192	208	219	209	241	238	228	229	239	252	159
117		84	125	152	173	197	203	219	160	233	246	244	256	250	273	189
118		98	143	183	200	226	229	***	***	***	***	***	***	***	***	***
119		90	135	164	194	220	238	252	251	270	287	275	277	295	319	229
120		87	132	174	195	219	229	247	236	276	275	268	265	289	307	220

*** ANIMAL DIED DURING TESTING.

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B. Food Consumption

The individual food consumption data are presented in Tables III and IV.

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TABLE III

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Food Consumption Data - Males

Group and Dietary Level (%)	Food Consumption (g/rat/7 days) Week: 1	2	3	4	5	6	7	8	9	10	11	12	13
Control (0)	135	185	194	200	199	158	184	183	166	182	194	180	219
	126	185	183	190	185	197	196	192	124	217	223	232	NA
	130	181	196	217	212	211	224	232	226	204	200	181	256
	104	146	181	197	204	222	239	192	209	224	227	218	NA
	122	167	155	195	226	198	226	206	216	165	176	144	234
T-I (0.1)	130	172	189	199	195	187	194	194	202	194	191	162	219
	135	177	185	192	169	180	195	212	214	222	192	155	167
	132	167	194	206	192	193	187	126	107	63	146	135	190
	128	168	183	187	185	190	196	186	178	190	168	144	177
	140	165	166	169	169	173	177	194	193	197	195	173	195
T-II (1.0)	127	172	185	179	184	191	151	104	125	117	121	111	132
	126	165	189	202	200	183	142	158	171	184	206	178	203
	126	169	188	189	193	192	176	185	193	204	193	164	185
	135	192	200	208	197	190	180	212	213	221	210	184	203
	129	179	179	187	171	182	174	183	186	193	192	161	172
T-III (10.0)	138	180	193	210	206	209	214	195	192	210	211	193	222
	141	179	204	210	196	212	214	214	217	224	221	187	214
	134	181	197	208	210	216	225	205	226	246	237	210	235
	130	174	178	193	178	183	195	191	191	197	192	181	201
	146	182	194	211	189	177	170	193	212	224	216	200	207

NA = Data not available - excessive spillage.

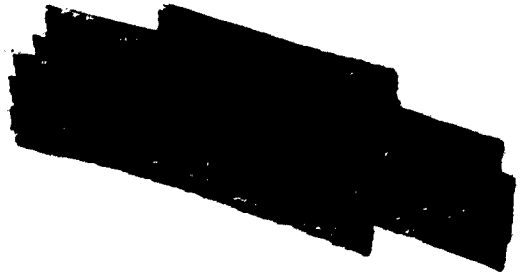

TABLE IV

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Food Consumption Data - Females

Group and Dietary Level (%)	Food Consumption (g/rat/7 days) Week: 1	2	3	4	5	6	7	8	9	10	11	12	13
Control (0)	94	111	173	205	188	150	141	141	118	131	113	110	130
	107	132	129	134	139	132	129	135	131	157	144	147	140
	112	141	134	140	220	159	153	230	167	137	121	115	156
	119	133	132	135	200	151	151	[illegible]18	64	163	141	170	156
	121	135	142	138	197	168	167	164	153	148	141	122	134
T-I (0.1)	96	111	103	103	102	109	110	109	115	109	110	94	135
	105	129	121	129	116	125	120	130	131	131	136	110	170
	127	153	151	163	159	162	134	145	173	171	162	130	113
	109	116	115	118	113	112	137	111	122	125	116	97	120
	101	120	115	115	123	127	151	160	135	138	121	110	113
T-II (1.0)	125	135	129	151	140	155	143	144	157	150	158	142	140
	118	136	128	138	131	143	142	153	146	146	123	114	161
	137	156	156	162	157	161	162	203	158	161	156	159	125
	100	121	118	124	123	124	125	146	119	123	109	78	144
	127	140	139	134	134	131	129	136	129	138	128	136	134
T-III (10.0)	114	144	141	147	153	147	150	155	161	160	158	122	172
	120	131	129	129	147	130	126	124	131	124	135	115	143
	131	137	133	150	134	140	144	145	153	152	162	140	156
	110	135	131	146	141	159	128	94	116	134	139	126	149
	128	133	132	144	137	116	103	[illegible]	[illegible]	149	144	135	150

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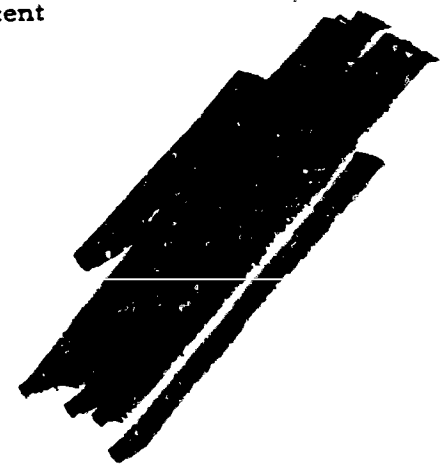
C. Hematologic Studies

Individual hematologic data are presented in Tables V through VIII. The key for the group coding indicated in the tables is presented below.

Group	Test Group Code Males	Females	Dietary Level (%)
Control	1	2	0
T-I	3	4	0.1
T-II	5	6	1.0
T-III	7	8	10.0

Units for the various parameters given are as follows:

WBC = thousands/mm^3
RBC = millions/mm^3
HGB = g/100 ml
HCT = percent
MCV = μ^3
MCH = $\mu\mu g$
MCHC = percent



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Industrial BIO-TEST Laboratories, Inc.

TABLE V

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Hematologic Data 40-Day

Lab No.	Date Rec	Animal Number	Test Group	WBC	RBC	HGB	HCT	MCV	MCH	MCHC
1	06-09	6	1	14.3	7.54	15.2	43.4	56.0	20.2	35.2
2	06-09	7	1	13.0	8.62	16.5	48.0	54.0	19.3	34.6
3	06-09	8	1	11.9	8.55	16.3	46.3	53.0	19.2	35.4
4	06-09	9	1	10.1	7.50	15.6	44.0	57.0	20.9	35.6
5	06-09	10	1	12.6	8.11	15.9	45.2	54.0	19.7	35.3
6	06-09	11	1	12.2	8.11	15.7	44.9	54.0	19.4	35.1
7	06-09	12	1	10.8	8.21	16.1	45.9	54.0	19.7	35.2
8	06-09	13	1	14.6	7.84	15.5	43.9	54.0	19.8	35.3
9	06-09	14	1	10.9	7.99	15.5	44.9	55.0	19.5	34.7
10	06-09	15	1	13.0	8.29	16.0	45.7	54.0	19.3	35.0
	Mean			12.34	8.08	15.83	45.22	54.50	19.70	35.14
	Standard Deviation			1.47	0.38	0.40	1.35	1.18	0.52	[illegible]
11	06-09	21	2	12.9	6.00	15.9	46.3	56.0	20.0	34.4
12	06-09	22	2	8.6	7.84	15.2	43.5	54.0	19.5	35.0
13	06-09	23	2	10.2	7.70	15.1	42.3	53.0	19.7	35.8
14	06-09	24	2	12.1	7.77	14.8	43.3	54.0	19.2	34.4
15	06-09	25	2	10.2	7.90	15.2	42.6	52.0	19.4	35.7
16	06-09	26	2	6.4	7.14	14.2	41.0	56.0	20.1	34.9
17	06-09	27	2	10.4	7.66	14.6	42.4	54.0	19.1	34.4
18	06-09	28	2	14.8	10.80	17.8	57.6	51.0	16.6	31.2
19	06-09	29	2	15.0	7.19	14.1	40.6	55.0	19.7	34.9
20	06-09	30	2	13.4	7.96	15.1	43.4	53.0	19.1	34.8
	Mean			11.40	8.00	15.20	44.30	53.80	19.24	34.55
	Standard Deviation			2.75	1.03	1.05	4.93	1.62	0.99	1.28
21	06-09	96	7	7.6	7.69	14.8	42.7	54.0	19.4	34.8
22	06-09	97a	7	19.9	4.29	8.3	28.0	63.0	19.4	30.0
23	06-09	98	7	8.5	7.19	13.8	40.1	54.0	19.4	34.7
24	06-09	99	7	12.0	8.15	15.9	46.1	55.0	19.6	34.6
25	06-09	100	7	10.0	7.77	15.1	43.5	54.0	19.5	34.8
26	06-09	101	7	9.0	7.94	14.9	43.7	53.0	18.9	34.3
27	06-09	102	7	9.8	8.01	15.1	44.1	53.0	19.0	34.4
28	06-09	103	7	15.0	8.24	14.9	43.4	51.0	18.2	34.4
29	06-09	104	7	13.8	8.04	14.7	44.0	53.0	18.3	33.5
30	06-09	105	7	8.4	7.42	14.8	42.8	56.0	20.0	34.7
	Mean			10.46	7.83	14.89**	43.38*	53.67	19.14*	34.47**
	Standard Deviation			2.58	0.35	0.54	1.58	1.41	0.60	0.41
31	06-09	111	8	9.3	6.54	11.9	37.2	55.0	18.3	32.2
32	06-09	112	8	8.8	7.48	13.7	41.8	55.0	18.6	32.8
33	06-09	113	8	6.9	7.86	14.8	43.8	53.0	18.0	32.7
34	06-09	114	8	9.5	7.52	13.8	42.9	55.0	[illegible]	32.5
35	06-09	115	8	8.4	7.65	13.9	43.3	55.0	[illegible]	32.3
36	06-09	116	8	7.6	7.87	14.8	38.8	53.0	19.9	36.3
37	06-09	117	8	10.4	7.16	14.3	40.1	54.0	20.1	35.8
38	06-09	118	8	8.3	7.05	13.9	39.7	55.0	19.9	35.1
39	06-09	119	8	8.1	7.46	13.3	43.2	56.0	18.0	31.0
40	06-09	120	8	8.1	8.00	13.9	44.8	54.0	17.5	31.2
	Mean			8.46**	7.37	13.67**	41.48	54.50	18.70	33.19
	Standard Deviation			1.01	0.43	0.67	2.41	0.97	0.91	1.87

a = Animal excluded from the mean.

* Statistically significant intergroup differences at the 95% ($P<0.05$) confidence level.

** Statistically significant intergroup differences at the 99% ($P<0.01$) confidence level.

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TABLE VI

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Hematologic Data 84-Day

Lab No.	Date Run	Animal Number	Test Group	WBC	RBC	HGB	HCT	MCV	MCH	MCHC
1	07-23	1[a]	1	21.8	13.38	16.2	71.8	51.0	12.2	22.9
2	07-23	3	1	17.6	9.30	16.2	48.8	50.0	17.2	33.1
3	07-23	5	1	19.4	10.20	17.2	50.6	47.0	16.9	34.2
4	07-23	6	1	18.0	9.34	16.0	48.8	49.0	17.1	33.0
5	07-23	7	1	12.8	9.70	17.0	50.8	50.0	17.3	33.4
6	07-23	8	1	16.2	9.84	16.8	51.4	49.0	17.0	32.7
7	07-23	9	1	13.2	9.40	16.4	50.6	51.0	17.4	32.6
8	07-23	10	1	11.8	9.14	15.6	48.8	50.0	16.8	31.9
9	07-23	11	1	16.4	10.00	16.8	52.4	50.0	16.8	32.3
10	07-23	12	1	13.4	9.74	16.6	51.8	50.0	17.1	32.3
	Mean			15.42	9.63	16.51	50.44	49.56	17.07	32.93
	Standard Deviation			2.69	0.36	0.51	1.36	1.13	0.21	0.69
11	07-23	17	2	13.3	8.27	15.6	46.2	53.0	18.8	33.7
12	07-23	18	2	12.4	8.57	14.9	46.6	52.0	17.4	32.0
13	07-23	19	2	8.1	8.94	14.8	49.7	53.0	16.3	29.7
14	07-23	20	2	13.1	9.75	14.7	53.9	53.0	15.1	27.3
15	07-23	21[a]	2	11.0	14.82	15.8	79.0	51.0	10.8	20.2
16	07-23	22	2	8.8	9.12	15.8	49.6	51.0	17.3	32.1
17	07-23	23	2	8.6	8.86	15.8	46.8	50.0	17.7	33.9
18	07-23	24	2	10.4	9.00	16.6	49.6	52.0	18.4	33.7
19	07-23	25	2	9.8	9.02	16.4	48.6	51.0	18.0	33.8
20	07-23	26	2	7.4	8.48	15.6	47.6	53.0	18.4	32.0
	Mean			10.21	8.89	15.58	48.73	52.00	17.51	32.13
	Standard Deviation			2.23	0.43	0.68	2.38	1.12	1.14	2.26
21	07-23	31	3	11.8	9.32	16.4	50.4	51.0	17.6	32.8
22	07-23	32	3	13.2	9.56	16.6	50.8	50.0	17.3	32.8
23	07-23	33	3	16.8	9.54	15.4	49.6	49.0	16.1	31.4
24	07-23	34	3	13.6	9.96	16.2	50.8	48.0	16.2	32.0
25	07-23	35	3	14.0	9.66	16.8	51.6	51.0	17.3	32.6
26	07-23	36	3	13.0	9.98	16.4	53.0	50.0	16.3	30.9
27	07-23	37	3	19.4	9.86	16.4	51.0	49.0	16.7	32.6
28	07-23	38	3	13.6	8.84	15.6	49.8	53.0	17.4	31.2
29	07-23	39	3	18.4	10.68	17.2	56.6	50.0	16.0	30.4
30	07-23	40	3	14.8	10.28	16.0	52.2	48.0	15.5	30.6
	Mean			15.86	9.77	16.10	51.58	49.90	16.64	31.75
	Standard Deviation			3.67	0.51	0.54	2.04	1.52	0.72	0.92
31	07-23	46	4	11.4	9.16	15.8	49.8	51.0	17.1	31.8
32	07-23	47	4	8.8	9.28	16.0	49.8	51.0	17.2	32.4
33	07-23	48	4	11.0	9.12	15.4	50.2	52.0	16.8	30.8
34	07-23	49	4	9.6	9.10	15.2	49.6	52.0	16.6	30.7
35	07-23	50	4	11.0	9.04	14.8	48.4	51.0	16.3	30.3
36	07-23	51	4	11.8	8.58	16.0	48.0	53.0	18.6	33.6
37	07-23	52	4	11.0	10.12	16.8	54.2	51.0	15.6	31.3
38	07-23	53	4	13.6	8.88	15.2	48.8	52.0	17.1	31.4
39	07-23	54	4	6.4	8.58	15.2	46.2	51.0	17.5	32.9
40	07-23	55	4	8.0	8.60	15.4	47.4	52.0	17.9	32.9
	Mean			9.96	9.05	15.58	49.24	51.60	17.17	31.86
	Standard Deviation			2.60	0.46	0.58	2.14	0.70	0.69	1.03

a = Animal excluded from the mean

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Industrial BIO-TEST Laboratories, Inc.

TABLE VI continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Hematologic Data 84-Day

Lab No.	Date Run	Animal Number	Test Group	WBC	RBC	HGB	HCT	MCV	MCH	MCHC
41	07-23	61	5	20.8	4.58	9.0	30.8	63.0	19.2	29.2
42	07-23	62	5	11.4	10.02	16.6	52.8	50.0	16.5	31.7
43	07-23	63	5	10.8	10.06	16.8	54.2	51.0	16.5	30.9
44	07-23	64	5	13.0	10.38	17.2	54.2	49.0	16.4	31.7
45	07-23	65	5	13.0	9.16	15.6	49.2	51.0	17.0	32.0
46	07-23	66	5	11.2	9.28	15.2	46.8	48.0	16.4	32.8
47	07-23	67	5	13.8	10.10	16.8	50.8	48.0	16.5	33.1
48	07-23	68	5	11.2	10.22	17.2	51.4	48.0	16.7	33.6
49	07-23	69	5	14.2	9.90	17.4	53.6	51.0	17.3	32.4
50	07-23	70	5	12.4	10.08	16.4	50.8	48.0	16.1	32.3
	Mean			13.18	9.38	15.82	49.46	50.70	16.86	31.97
	Standard Deviation			2.92	1.73	2.50	6.96	4.52	0.89	1.24
51	07-23	76	6	8.6	8.02	15.6	46.0	54.0	19.3	34.1
52	07-23	77	6	5.8	8.12	14.6	42.6	49.0	18.0	34.8
53	07-23	78	6	7.2	8.44	14.8	45.6	51.0	17.4	32.6
54	07-23	79	6	6.6	8.40	15.6	46.6	52.0	18.4	33.6
55	07-23	80	6	10.6	8.64	15.6	46.4	51.0	17.9	33.6
56	07-23	81	6	6.8	7.88	14.8	42.4	51.0	18.7	35.2
57	07-23	82	6	5.6	8.52	15.2	46.8	52.0	17.7	32.7
58	07-23	83	6	6.6	8.32	14.2	44.6	50.0	16.9	32.0
59	07-23	84	6	4.6	8.16	15.6	44.8	52.0	19.0	35.1
60	07-23	85	6	6.8	8.18	15.2	45.0	52.0	18.5	33.9
	Mean			6.92**	8.27**	15.12	45.08**	51.40	18.18	33.76
	Standard Deviation			1.67	0.24	0.50	1.56	1.35	0.74	1.09
61	07-23	91	7	7.0	9.32	15.8	47.6	48.0	16.8	33.4
62	07-23	92	7	12.0	8.76	15.6	44.6	48.0	17.6	34.9
63	07-23	93	7	14.4	8.54	15.8	46.0	51.0	18.4	34.6
64	07-23	94	7	11.6	8.70	14.8	45.2	49.0	17.0	33.1
65	07-23	95	7	10.0	8.80	16.0	46.8	50.0	18.0	34.2
66	07-23	96	7	10.4	8.10	13.8	44.2	51.0	16.8	31.3
67	07-23	97	7	10.2	9.18	15.8	47.2	49.0	17.1	33.7
68	07-23	98	7	11.8	9.14	15.8	46.6	48.0	17.2	34.1
69	07-23	99	7	11.8	8.78	16.4	46.4	50.0	18.5	35.0
70	07-23	100	7	11.2	9.86	17.2	50.8	49.0	17.2	33.7
	Mean			11.04*	8.92	15.70	46.54	49.30	17.47	33.83
	Standard Deviation			1.89	0.48	0.90	1.86	1.16	0.65	1.18
71	07-23	106	8	10.8	8.38	15.6	46.6	52.0	18.4	34.0
72	07-23	107	8	8.8	8.10	14.8	44.4	52.0	18.2	33.7
73	07-23	108	8	6.6	8.00	14.6	44.0	51.0	18.0	33.5
74	07-23	109	8	7.4	8.38	15.2	44.8	50.0	18.1	34.2
75	07-23	110	8	10.2	8.74	14.0	48.6	53.0	18.1	33.0
76	07-23	111	8	7.2	8.56	15.6	46.8	52.0	18.4	34.0
77	07-23	114	8	9.2	8.38	15.0	45.2	51.0	17.7	33.2
78	07-23	115	8	9.2	8.02	14.4	43.2	51.0	17.8	33.4
79	07-23	116	8	8.0	8.74	15.2	46.4	50.0	17.4	33.1
80	07-23	117	8	6.2	7.94	15.0	43.0	51.0	18.7	35.0
	Mean			8.36	8.33*	15.14	45.24**	51.30	18.08	33.71
	Standard Deviation			1.53	0.29	0.51	1.74	0.95	0.38	0.61

a = Animal excluded from the mean.
* Statistically significant intergroup difference at the 95% (P<0.05) confidence level.
** Statistically significant intergroup difference at the 99% (P<0.01) confidence level.

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TABLE VII

TEST MATERIAL: FireMaster®680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Hematologic Data - Males

Group and Dietary Level (%)	Animal Number		Differential Leukocyte Count (Number of Cells Per Hundred) Lymphocytes Day:		Neutrophils Day:		Monocytes Day:		Eosinophils Day:		Basophils Day:		Bands Day:	
	Day: 40	84	40	84	40	84	40	84	40	84	40	84	40	84
Control (0)	6	1	89	88	9	11	2	0	0	0	0	0	0	1
	7	3	85	90	14	9	1	1	0	0	0	0	0	0
	8	5	79	87	19	12	2	0	0	1	0	0	0	1
	9	6	82	83	18	14	0	1	0	1	0	0	0	1
	10	7	85	84	14	8	1	2	0	0	0	0	0	1
	11	8	86	64	8	34	3	1	2	1	0	0	1	0
	12	9	83	85	17	13	0	0	0	0	0	0	0	2
	13	10	86	74	9	24	3	1	1	0	0	0	1	1
	14	11	74	86	22	10	1	3	0	0	0	0	3	1
	15	12	77	87	20	11	2	1	1	1	0	0	0	0
T-I (0.1)		31		85		13		0		0		0		2
		32		80		17		1		2		0		0
		33		80		16		1		2		0		1
		34		87		12		1		0		0		0
		35		86		10		1		0		0		3
		36		81		15		0		4		0		0
		37		87		11		1		1		0		0
		38		87		10		0		1		0		2
		39		90		8		1		0		0		1
		40		85		13		1		1		0		0
T-II (1.0)		61		75		23		0		1		0		1
		62		88		12		0		0		0		0
		63		91		9		0		0		0		0
		64		85		15		0		0		0		0
		65		58		42		0		0		0		0
		66		71		26		1		1		0		1
		67		90		9		0		1		0		0
		68		76		22		2		0		0		0
		69		85		14		0		0		0		1
		70		86		14		0		0		0		0
T-III (10.0)	96	91	83	84	16	15	1	0	0	1	0	0	0	0
	97	92	76	89	17	6	2	2	0	2	0	0	3	1
	98	93	83	87	14	12	2	0	0	1	0	0	1	0
	99	94	87	79	11	21	2	0	0	0	0	0	0	0
	100	95	75	84	24	15	0	0	1	1	0	0	0	0
	101	96	86	90	14	9	0	1	0	0	0	0	0	0
	102	97	79	76	19	23	1	1	1	0	0	0	0	0
	103	98	91	94	7	5	2	1	0	0	0	0	0	0
	104	99	83	88	13	12	2	0	1	0	0	0	1	0
	105	100	85	91	12	9	2	0	1	0	0	0	0	0

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TEST MATERIAL: FireMaster®680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Hematologic Data - Females

Group and Dietary Level (%)	Animal Number Day: 40	84	Lymphocytes Day: 40	84	Neutrophils Day: 40	84	Monocytes Day: 40	84	Eosinophils Day: 40	84	Basophils Day: 40	84	Bands Day: 40	84
					Differential Leukocyte Count (Number of Cells Per Hundred)									
Control (0)	21	17	91	85	6	12	3	1	0	2	0	0	0	0
	22	18	85	72	12	28	2	0	1	0	0	0	0	0
	23	19	86	87	14	11	0	1	0	1	0	0	0	0
	24	20	95	80	5	18	0	0	0	1	0	0	0	0
	25	21	93	84	3	16	1	0	2	0	0	0	1	0
	26	22	77	88	21	11	1	0	0	1	0	0	1	0
	27	23	83	73	15	22	2	2	0	3	0	0	0	0
	28	24	72	93	24	7	1	0	1	0	0	0	2	0
	29	25	89	78	9	20	1	1	0	1	0	0	1	0
	30	26	94	81	6	16	0	0	0	3	0	0	0	0
T-I (0.1)		46		85		14		0		1		0		0
		47		82		15		1		2		0		0
		48		79		20		0		1		0		0
		49		83		17		0		0		0		0
		50		80		18		1		0		0		1
		51		85		15		0		0		0		0
		52		76		21		0		3		0		0
		53		82		13		2		1		0		2
		54		79		20		0		1		0		0
		55		74		26		0		0		0		0
T-II (1.0)		76		89		8		2		1		0		0
		77		87		12		0		1		0		0
		78		88		10		1		0		0		1
		79		95		5		0		0		0		0
		80		90		8		0		2		0		0
		81		87		9		2		1		0		1
		82		74		25		1		0		0		0
		83		85		15		0		0		0		0
		84		82		16		0		2		0		0
		85		83		15		0		2		0		0
T-III (10.0)	111	106	87	90	11	10	1	0	1	0	0	0	0	0
	112	107	87	81	13	18	0	0	0	1	0	0	0	0
	113	108	84	78	14	22	1	0	0	0	0	0	1	0
	114	109	83	84	17	14	0	1	0	1	0	0	0	0
	115	110	67	80	30	20	1	0	0	0	0	0	2	0
	116	111	30	85	15	13	2	1	2	1	0	0	1	0
	117	114	82	79	13	19	3	2	1	0	0	0	1	0
	118	115	78	81	21	17	0	0	1	0	0	0	0	2
	119	116	79	79	19	18	1	1	0	2	0	0	1	0
	120	117	78	69	21	28	1	2	0	1	0	0	0	0

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D. Clinical Blood Chemistry Data

The individual clinical blood chemistry data are presented in Tables IX and X.

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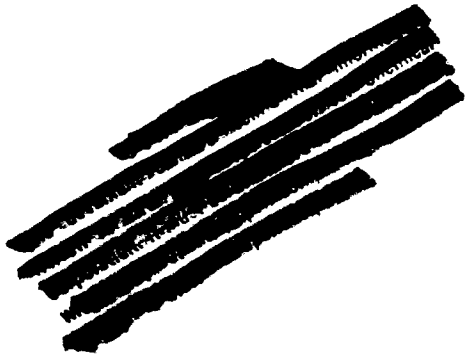

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TABLE IX

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Clinical Blood Chemistry Data - Males

Group and Dietary Level (%)	Animal Number	Serum Alkaline Phosphatase Activity (I.U./L) Day:		Serum Glutamic Pyruvic Transaminase Activity (I.U./L) Day:	
	Day: 40	84	40	84	40	84
Control (0)	6	1	72	128	15	23
	7	3	95	81	18	18
	8	5	82	90	15	35
	9	6	138	61	15	20
	10	7	113	72	24	15
	11	8	107	63	20	20
	12	9	93	94	21	15
	13	10	66	76	18	98*
	14	11	85	58	18	18
	15	12	125	66	23	18
T-I (0.1)		31		70		25
		32		83		20
		33		87		17
		34		79		12
		35		110		17
		36		97		20
		37		78		17
		38		61		23
		39		104		43
		40		58		23
T-II (1.0)		61		108		21
		62		75		14
		63		63		15
		64		51		21
		65		61		21
		66		104		24
		67		115		17
		68		51		14
		69		93		18
		70		240*		40*
T-III (10.0)	96	91	151	107	18	17
	97	92	170	109	18	14
	98	93	109	128	23	20
	99	94	128	101	15	26
	100	95	178	70	18	25
	101	96	117	98	15	26
	102	97	114	98	23	17
	103	98	160	83	18	20
	104	99	204*	118	18	28
	105	100	89	105	14	18

* Value not included in the mean.

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TABLE IX continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Clinical Blood Chemistry Data - Males

Group and Dietary Level (%)	Animal Number Day: 40	84	Fasting Blood Glucose Concentration (mg/100 ml). Day: 40	84	Blood Urea Nitrogen Concentration (mg/100 ml) Day: 40	84
Control (0)	6	1	129	127	11	16
	7	3	135	126	14	13
	8	5	125	178	14	17
	9	6	125	157	15	14
	10	7	145	140	14	14
	11	8	127	157	16	13
	12	9	114	144	13	16
	13	10	132	139	12	18
	14	11	151	133	12	18
	15	12	139	122	17	13
T-I (0.1)		31		133		16
		32		121		17
		33		104		15
		34		115		16
		35		132		17
		36		135		21
		37		127		15
		38		122		16
		39		171		20
		40		137		19
T-II (1.0)		61		87		15
		62		110		15
		63		110		15
		64		139		34*
		65		148		23
		66		129		21
		67		144		20
		68		157		18
		69		119		14
		70		265*		24
T-III (10.0)	96	91	97	120	13	13
	97	92	113	183	13	17
	98	93	117	116	14	17
	99	94	105	98	14	17
	100	95	116	105	16	15
	101	96	103	114	11	22
	102	97	96	104	16	15
	103	98	125	132	16	17
	104	99	124	110	19	17
	105	100	113	123	14	16

* Value not included in the mean.

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Industrial BIO-TEST Laboratories, Inc.

TABLE X

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Clinical Blood Chemistry Data - Females

Group and Dietary Level (%)	Animal Number Day: 40	84	Serum Alkaline Phosphatase Activity (I.U./L) Day: 40	84	Serum Glutamic Pyruvic Transaminase Activity (I.U./L) Day: 40	84
Control (0)	21	17	48	32	15	10
	22	18	32	25	17	14
	23	19	33	34	17	17
	24	20	46	28	15	24
	25	21	62	34	18	15
	26	22	47	20	12	10
	27	23	43	26	10	11
	28	24	85	30	81*	31
	29	25	43	46	12	17
	30	26	41	33	18	11
T-I (0.1)		46		37		18
		47		34		18
		48		29		12
		49		24		14
		50		33		34
		51		41		12
		52		39		14
		53		34		15
		54		33		18
		55		29		14
T-II (1.0)		76		32		14
		77		27		20
		78		35		21
		79		56		14
		80		24		40
		81		30		18
		82		29		18
		83		33		11
		84		29		23
		85		27		21
T-III (10.0)	111	106	58	24	14	14
	112	107	41	40	15	17
	113	108	56	18	14	29
	114	109	51	36	15	20
	115	110	48	29	15	12
	116	111	29	30	12	37
	117	114	49	18	15	21
	118	115	38	25	14	11
	119	116	66	14	14	18
	120	117	55	25	12	2[illegible]

* Value not included in the mean.

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TABLE X continued

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Clinical Blood Chemistry Data - Females

Group and Dietary Level (%)	Animal Number Day: 40	84	Fasting Blood Glucose Concentration (mg/100 ml) Day: 40	84	Blood Urea Nitrogen Concentration (mg/100 ml) Day: 40	84
Control (0)	21	17	146	154	16	14
	22	18	119	148	15	14
	23	19	128	150	12	13
	24	20	134	164	12	15
	25	21	129	136	15	16
	26	22	119	140	13	13
	27	23	122	133	14	14
	28	24	68*	133	22	14
	29	25	133	134	12	16
	30	26	130	134	14	14
T-I (0.1)		46		112		18
		47		112		17
		48		141		16
		49		128		20
		50		127		15
		51		153		14
		52		134		17
		53		134		15
		54		138		17
		55		112		16
T-II (1.0)		76		135		15
		77		148		16
		78		143		14
		79		136		18
		80		126		16
		81		113		12
		82		136		14
		83		122		19
		84		130		14
		85		123		18
T-III (10.0)	111	106	133	126	15	15
	112	107	126	122	14	18
	113	108	114	116	13	16
	114	109	130	111	14	20
	115	110	124	130	14	20
	116	111	117	119	14	16
	117	114	159	115	13	17
	118	115	157	101	14	13
	119	116	137	112	16	13
	120	117	133	120	14	14

* Value not included in the mean.

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E. Urinalyses

The individual urinalyses data are presented in Tables XI and XII.

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Industrial BIO-TEST Laboratories, Inc.

TABLE XI

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Urinalyses Data - Males

Group and Dietary Level (%)	Animal Number Day: 40	84	Glucose Day: 40	84	Albumin Day: 40	84	pH Day: 40	84	Specific Gravity Day: 40	84	Microscopic Elements* Day: 40	84
Control (0)	6	1	n	n	n	n	7	7	1.020	1.041	+1	n
	7	3	n	n	n	n	8	7	1.021	1.026	n	n
	8	5	n	n	n	n	6	6	1.013	1.040	+1	n
	9	6	n	n	n	n	8	7	1.016	1.019	n	n
	10	7	n	n	n	n	7	7	1.012	1.017	+1	n
	11	8	n	n	n	n	7	7	1.010	1.024	n	n
	12	9	n	n	n	n	7	6	1.011	1.029	n	t
	13	10	n	n	n	n	7	7	1.014	1.019	n	+1
	14	11	n	n	n	n	8	7	1.017	1.017	+2	n
	15	12	n	n	n	n	8	7	1.015	1.018	-2	
T-I (0.1)		31		n		n		7		1.019		+2
		32		n		n		7		1.029		n
		33		n		n		7		1.030		n
		34		n		n		7		1.029		n
		35		n		n		7		1.032		+1
		36		n		n		7		1.019		n
		37		n		n		7		1.012		t
		38		n		n		7		1.017		n
		39		n		n		7		1.032		n
		40		n		n		7		1.018		t
T-II (1.0)		61		n		t		6		1.007		n
		62		n		n		7		1.029		n
		63		n		n		7		1.024		+1
		64		n		t		6		1.012		+1
		65		n		n		7		1.034		n
		66		n		n		7		1.019		+1
		67		n		n		7		1.022		n
		68		n		n		7		1.024		n
		69		n		t		8		1.015		n
		70		n						1.018		+1
T-III (10.0)	96	91	n	n	n	n	8	8	1.016	1.015	+2	n
	97	92	n	n	n	n	8	8	1.018	1.011	n	n
	98	93	n	n	n	t	7	7	1.018	1.015	n	n
	99	94	n	n	n	t	7	6	1.022	1.010	+1	n
	100	95	n	n	n	t	7	7	1.010	1.015	+1	+1
	101	96	n	n	n	+1	6	8	1.007	1.014	n	+2
	102	97	n	n	n	+1	7	7	1.026	1.011	+1	n
	103	98	n	n	n	t	6	8	1.010	1.010	n	n
	104	99	n	n	n	n	7	8	1.007	1.012	+2	+2
	105	100	n	n	n	t	5	5	1.005	1.010	+2	+1

* Crystals

Key:
- n = negative or normal
- t = minimal or trace
- +1 = slight amount
- +2 = moderate amounts

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TABLE XI:

TEST MATERIAL: FireMaster® 680

90-Day Subacute Oral Toxicity Study - Albino Rats

Individual Urinalyses Data - Females

Group and Dietary Level (%)	Animal Number: Day: 40	84	Glucose Day: 40	84	Albumin Day: 40	84	pH Day: 40	84	Specific Gravity Day: 40	84	Microscopic Elements Day: 40	84
Control (0)	21	17	n	n	n	n	7	8	1.012	1.008	n	n
	22	18	n	n	n	n	8	7	1.013	1.022	n	n
	23	19	n	n	n	n	7	7	1.033	1.017	+3	n
	24	20	n	n	n	n	7	7	1.022	1.011	+1	n
	25	21	n	n	n	n	8	7	1.034	1.012	+2	t
	26	22	n	n	n	n	7	6	1.008	1.016	+1	n
	27	23	n	n	n	n	7	8	1.016	1.017	+1	n
	28	24	n	n	n	n	7	7	1.045	1.024	n	n
	29	25	n	n	n	+2	6	9	1.012	1.021	n	n
	30	26	n	n	n	n	7	7	1.026	1.019	+2	t
T-I (0.1)		46		n		n		6		1.030		n
		47		n		n		7		1.010		n
		48		n		n		7		1.012		n
		49		n		n		7		1.015		n
		50		n		n		7		1.019		n
		51		n		n		7		1.013		n
		52		n		n		7		1.010		n
		53		n		n		7		1.019		n
		54		n		n		7		1.010		n
		55		n		n		6		1.012		n
T-II (1.0)		76		n		n		5		1.012		n
		77		n		n		7		1.015		n
		78		n		n		7		1.012		n
		79		n		n		7		1.007		n
		80		n		n		7		1.022		n
		81		n		n		7		1.007		n
		82		n		n		7		1.019		n
		83		n		n		8		1.017		+1
		84		n		n		6		1.014		n
		85		n		n		6		1.010		n
T-III (10.0)	111	106	n	n	n	n	6	7*	1.034	1.007	+1	n
	112	107	n	n	n	n	6	6	1.012	1.019	n	n
	113	108	n	n	n	n	7	7	1.008	1.010	+1	n
	114	109	n	n	n	t	7	7	1.008	1.011	n	+1
	115	110	n	n	n	n	7	5	1.009	1.017	+1	n
	116	111	n	n	n	n	6	6	1.007	1.024	+1	n
	117	114	n	n	n	n	6	7	1.016	1.014	+1	n
	118	115	n	n	n	n	6	7	1.006	1.015	n	+2
	119	116	n	n	n	n	7	7	1.010	1.007	n	n
	120	117	n	n	n	n	7	5	1.017	1.017	+1	n

* Crystals

Key:

n = negative or normal
t = minimal or trace
+1 = slight amounts
+2 = moderate amounts
+3 = large amounts

F. Organ Weight Data

The individual organ weight data are presented in Tables XIII through XXIV. The body weights used in the calculation of the organ to body weight ratios are presented in Tables XXV and XXVI.

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TABLE XIII

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BRAIN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	2.194	0.44056	1.00000
		3	2.254	0.37755	1.00000
		5	2.249	0.40377	1.00000
		6	2.198	0.43268	1.00000
		7	2.190	0.48884	1.00000
		8	2.034	0.49975	1.00000
		9	2.156	0.38431	1.00000
		10	2.129	0.37091	1.00000
		11	2.090	0.38000	1.00000
		12	2.300	0.43396	1.00000
		13	2.058	0.38111	1.00000
		14	2.211	0.39982	1.00000
		15	2.207	0.42854	1.00000
T-1	0.1	31	2.191	0.39982	1.00000
		32	2.382	0.44440	1.00000
		33	2.104	0.44576	1.00000
		34	2.120	0.42400	1.00000
		35	2.197	0.46350	1.00000
		36	2.108	0.44851	1.00000
		37	2.282	0.38033	1.00000
		38	2.209	0.44180	1.00000
		39	2.263	0.41830	1.00000
		40	2.134	0.38800	1.00000
		41	2.251	0.46896	1.00000
		42	2.144	0.41470	1.00000
		43	2.226	0.43819	1.00000
		44	2.208	0.42462	1.00000
		45	2.265	0.40374	1.00000

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TABLE XIII CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BRAIN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	61	2.138	0.61086	1.00000
		62	2.099	0.38514	1.00000
		63	2.282	0.44397	1.00000
		64	2.201	0.40460	1.00000
		65	2.316	0.51239	1.00000
		66	2.173	0.47969	1.00000
		67	2.204	0.38066	1.00000
		68	2.237	0.38503	1.00000
		69	2.144	0.44025	1.00000
		70	2.215	0.40568	1.00000
		71	2.177	0.46418	1.00000
		72	2.283	0.43652	1.00000
		73	2.093	0.42454	1.00000
		74	2.131	0.40590	1.00000
		75	2.191	0.41418	1.00000
T-III	10.0	91	2.289	0.40513	1.00000
		92	1.982	0.36840	1.00000
		93	2.000	0.33501	1.00000
		94	2.259	0.45636	1.00000
		95	2.379	0.48061	1.00000
		96	2.016	0.37542	1.00000
		97	2.389	0.45987	1.00000
		98	2.040	0.37091	1.00000
		99	1.993	0.42677	1.00000
		100	2.213	0.43909	1.00000
		101	2.154	0.44049	1.00000
		102	1.944	0.37602	1.00000
		103	2.238	0.41140	1.00000
		104	2.162	0.42727	1.00000
		105	2.101	0.37585	1.00000

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TABLE XIV

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BRAIN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	1.890	0.68478	1.00000
		18	1.772	0.56613	1.00000
		20	1.962	0.56542	1.00000
		21	1.721	0.54809	1.00000
		22	1.701	0.62308	1.00000
		23	1.711	0.66318	1.00000
		24	1.824	0.64911	1.00000
		25	1.699	0.75848	1.00000
		26	1.731	0.65817	1.00000
		27	1.743	0.52500	1.00000
		29	1.873	0.58349	1.00000
T-1	0.1	47	1.812	0.72191	1.00000
		48	1.739	0.54858	1.00000
		49	1.741	0.65451	1.00000
		50	1.787	0.64281	1.00000
		51	1.698	0.68193	1.00000
		52	1.681	0.65409	1.00000
		53	1.760	0.59661	1.00000
		54	1.787	0.57460	1.00000
		55	1.813	0.62734	1.00000
		56	1.877	0.63627	1.00000
		57	1.811	0.58990	1.00000
		58	1.819	0.52572	1.00000
		59	1.763	0.63417	1.00000
		60	1.794	0.54695	1.00000

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TABLE XIV CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BRAIN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	1.834	0.60131	1.00000
		78	2.001	0.56208	1.00000
		79	1.832	0.68614	1.00000
		80	1.659	0.53344	1.00000
		82	1.774	0.57411	1.00000
		83	1.714	0.65670	1.00000
		84	1.830	0.61204	1.00000
		85	1.859	0.65000	1.00000
		86	1.760	0.55696	1.00000
		87	1.705	0.60893	1.00000
		88	1.813	0.56130	1.00000
		89	1.851	0.55753	1.00000
		90	1.754	0.48722	
T-III	10.0	106	1.853	0.65246	1.00000
		107	1.842	0.67721	1.00000
		108	1.713	0.62065	1.00000
		114	1.753	0.56916	1.00000
		115	1.866	0.65704	1.00000
		116	1.805	0.66852	1.00000
		117	1.760	0.65918	1.00000
		119	1.878	0.58871	1.00000
		120	1.694	0.54295	1.00000

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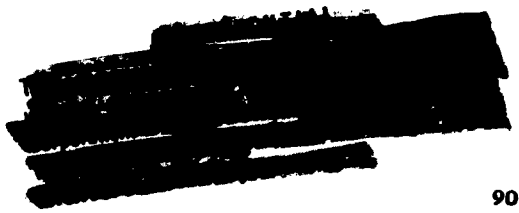

TABLE XV

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BOTH GONADS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	3.590	0.72088	1.63628
		3	3.470	0.58124	1.53949
		5	3.450	0.61939	1.53402
		6	3.430	0.67520	1.56051
		7	3.460	0.77232	1.57991
		8	3.280	0.80590	1.61259
		9	3.280	0.58467	1.52134
		10	3.570	0.62195	1.67684
		11	3.430	0.62364	1.64115
		12	3.820	0.72075	1.66087
		13	3.040	0.56296	1.47716
		14	3.100	0.56058	1.40208
		15	3.610	0.70097	1.63570
T-1	0.1	31	3.290	0.60036	1.50160
		32	3.340	0.62313	1.40218
		33	3.160	0.66949	1.50190
		34	3.530	0.70600	1.66509
		35	3.190	0.67300	1.45198
		36	3.200	0.68085	1.51803
		37	3.850	0.64167	1.68712
		38	3.240	0.64800	1.46673
		39	3.110	0.57486	1.37428
		40	3.320	0.60364	1.55576
		41	3.330	0.69375	1.47934
		42	1.580	0.30561	0.73694
		43	3.430	0.67520	1.54088
		44	2.050	0.39423	0.92844
		45	3.630	0.64706	1.60265

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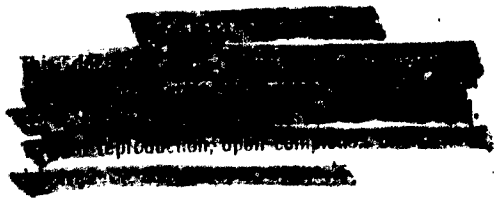

TABLE XV CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BOTH GONADS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	61	3.300	0.94286	1.54350
		62	3.300	0.60550	1.57218
		63	3.620	0.70428	1.58633
		64	3.690	0.67831	1.67651
		65	4.180	0.92478	1.80484
		66	3.760	0.83002	1.73033
		67	3.280	0.56649	1.48820
		68	3.440	0.59208	1.53777
		69	3.420	0.70226	1.59515
		70	3.370	0.61722	1.52144
		71	3.490	0.74414	1.60312
		72	3.210	0.61377	1.40604
		73	3.350	0.67951	1.60057
		74	3.010	0.57333	1.41248
		75	3.280	0.62004	1.49703
T-III	10.0	91	3.470	0.61416	1.51595
		92	3.340	0.62082	1.68517
		93	3.620	0.60637	1.81000
		94	3.770	0.76162	1.66888
		95	3.160	0.63838	1.32829
		96	3.350	0.62384	1.66171
		97	3.670	0.77101	1.67656
		98	3.010	0.54727	1.47549
		99	3.550	0.76017	1.78123
		100	3.400	.67460	1.53638
		101	3.130	0.64009	1.45311
		102	3.310	0.64023	1.70267
		103	3.490	0.64154	1.55943
		104	3.290	0.65020	1.52174
		105	3.400	0.60822	1.6[illegible]

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TABLE XVI

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BOTH GONADS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	0.098	0.03551	0.05185
		18	0.134	0.04281	0.07562
		20	0.074	0.02133	0.03772
		21	0.114	0.03631	0.06624
		22	0.110	0.04029	0.06467
		23	0.081	0.03140	0.04734
		24	0.110	0.03915	0.06031
		25	0.115	0.05134	0.06769
		26	0.090	0.03422	0.05199
		27	0.132	0.03976	0.07573
		29	0.105	0.03271	0.05606
T-1	0.1	47	0.087	0.03466	0.04801
		48	0.078	0.02461	0.04485
		49	0.064	0.02406	0.03676
		50	0.067	0.02410	0.03749
		51	0.125	0.05020	0.07362
		52	0.125	0.04864	0.07436
		53	0.130	0.04407	0.07386
		54	0.070	0.02251	0.03917
		55	0.092	0.03183	0.05074
		56	0.074	0.02508	0.03942
		57	0.088	0.02866	0.04859
		58	0.102	0.02948	0.05607
		59	0.099	0.03561	0.05615
		60	0.052	0.01585	0.02899

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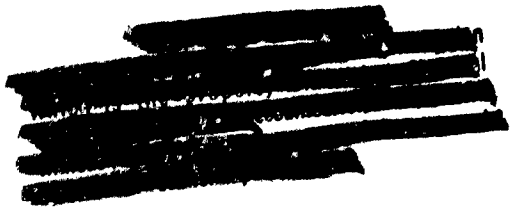

TABLE XVI CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BOTH GONADS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	0.105	0.03443	0.05725
		78	0.071	0.01994	0.03548
		79	0.080	0.02996	0.04367
		80	0.098	0.03151	0.05907
		82	0.082	0.02654	0.04622
		83	0.090	0.03448	0.05251
		84	0.084	0.02809	0.04590
		85	0.092	0.03217	0.04949
		86	0.083	0.02627	0.04716
		87	0.086	0.03071	0.05044
		88	0.095	0.02941	0.05240
		89	0.077	0.02319	0.04160
		90	0.117	0.03250	0.06670
T-III	10.0	106	0.114	0.04014	0.06152
		107	0.077	0.02031	0.04180
		108	0.090	0.03261	0.05254
		114	0.090	0.02922	0.05134
		115	0.089	0.03184	0.04770
		116	0.114	0.04222	0.06316
		117	0.094	0.03529	0.05341
		119	0.084	0.02630	0.04473
		120	0.098	0.03145	0.05785

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TABLE XVII

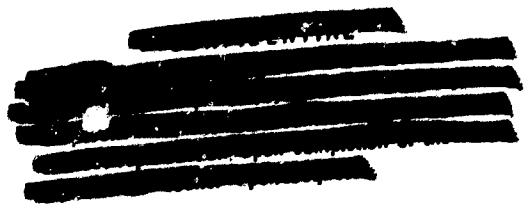
TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - HEART

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	1.530	0.30723	0.69736
		3	1.800	0.30151	0.79858
		5	1.910	0.34291	0.84927
		6	1.520	0.29921	0.69154
		7	1.340	0.29911	0.61197
		8	1.610	0.39558	0.79154
		9	1.590	0.28342	0.73748
		10	1.600	0.27875	0.75153
		11	1.860	0.33918	0.88995
		12	1.780	0.33585	0.77391
		13	1.630	0.30165	0.79203
		14	1.540	0.27848	0.69652
		15	1.530	0.29709	0.69325
T-1	0.1	31	1.760	0.32117	0.80329
		32	1.690	0.31530	0.70949
		33	1.340	0.28390	0.63688
		34	1.680	0.33600	0.79245
		35	1.670	0.35232	0.76013
		36	1.340	0.28511	0.63567
		37	1.970	0.32833	0.86328
		38	1.520	0.30400	0.68809
		39	1.520	0.28096	0.67167
		40	1.840	0.33455	0.86223
		41	1.620	0.33750	0.71968
		42	1.600	0.30948	0.74627
		43	1.640	0.32283	0.73675
		44	1.700	0.32692	0.76993
		45	1.740	0.31016	0.76821



Industrial BIO-TEST Laboratories, Inc.

TABLE XVII CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - HEART

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	61	1.500	0.45714	0.74836
		62	1.680	0.30826	0.80038
		63	1.710	0.33268	0.74934
		64	1.530	0.27941	0.69060
		65	1.730	0.38274	0.74698
		66	1.750	0.38631	0.80534
		67	1.600	0.27634	0.72595
		68	1.900	0.32702	0.84935
		69	1.590	0.32649	0.74160
		70	1.770	0.32413	0.79910
		71	1.530	0.32623	0.70280
		72	1.770	0.33843	0.77530
		73	1.760	0.35700	0.84090
		74	1.560	0.29714	0.73205
		75	1.460	0.27599	0.66636
T-III	10.0	91	1.600	0.28319	0.69900
		92	1.530	0.28439	0.77195
		93	1.610	0.26968	0.80500
		94	1.530	0.30909	0.87729
		95	1.730	0.34949	0.72720
		96	1.660	0.30912	0.82341
		97	1.490	0.31303	0.68068
		98	1.720	0.31273	0.84314
		99	1.340	0.28694	0.67235
		100	1.410	0.27976	0.63714
		101	1.430	0.29243	0.66388
		102	1.670	0.32302	0.85905
		103	1.500	0.29044	0.70599
		104	1.540	0.30435	0.71230
		105	1.570	0.28086	0.73510

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TABLE XVIII

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - HEART

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	1.070	0.38768	0.56614
		18	1.140	0.36422	0.64334
		20	1.270	0.36599	0.64730
		21	1.240	0.39490	0.72051
		22	1.050	0.38462	0.61728
		23	1.170	0.45349	0.68381
		24	1.220	0.43416	0.66886
		25	0.970	0.43304	0.57092
		26	1.110	0.42205	0.64125
		27	1.140	0.34337	0.65404
		29	1.100	0.34268	0.58729
T-1	0.1	47	1.110	0.44223	0.61258
		48	1.220	0.38486	0.70155
		49	1.190	0.44737	0.68352
		50	1.110	0.39928	0.62115
		51	0.890	0.35743	0.52415
		52	1.090	0.40078	0.61273
		53	1.400	0.47458	0.79545
		54	1.090	0.35048	0.60996
		55	1.100	0.38062	0.60673
		56	1.210	0.41017	0.64465
		57	0.950	0.30915	0.52457
		58	1.070	0.30925	0.58824
		59	1.180	0.42446	0.66931
		60	1.110	0.35841	0.61873

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TABLE XVIII CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - HEART

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	1.260	0.41311	0.68702
		78	1.440	0.40449	0.71964
		79	1.110	0.41573	0.60590
		80	1.160	0.37299	0.69922
		82	1.020	0.33010	0.57497
		83	0.950	0.36398	0.55426
		84	1.040	0.34785	0.56831
		85	1.150	0.40210	0.61861
		86	1.090	0.34494	0.61932
		87	1.250	0.44643	0.73314
		88	1.150	0.35604	0.63431
		89	1.120	0.33735	0.60508
		90	1.170	0.32500	0.66705
T-III	10.0	106	1.140	0.40141	0.61522
		107	1.010	0.37132	0.54832
		108	1.080	0.39130	0.63047
		114	1.110	0.36039	0.63320
		115	1.280	0.45070	0.68596
		116	1.160	0.42963	0.64266
		117	1.110	0.41573	0.63068
		119	1.330	0.41693	0.70820
		120	1.120	0.35897	0.66116

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TABLE XIX

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BOTH KIDNEYS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	3.540	0.71084	1.61349
		3	3.890	0.65159	1.72582
		5	4.360	0.78276	1.93864
		6	3.240	0.63780	1.47407
		7	3.010	0.67187	1.37443
		8	3.020	0.74201	1.48476
		9	3.880	0.69162	1.79963
		10	4.150	0.72300	1.94927
		11	3.930	0.71455	1.88038
		12	3.620	0.68302	1.57391
		13	3.770	0.69815	1.83188
		14	3.910	0.70705	1.76843
		15	4.050	0.78641	1.83507
T-1	0.1	31	3.470	0.63321	1.58375
		32	3.980	0.74254	1.67086
		33	3.090	0.65466	1.46863
		34	3.770	0.75400	1.77830
		35	3.690	0.77848	1.67956
		36	3.510	0.74681	1.66509
		37	3.890	0.64833	1.70465
		38	3.580	0.71600	1.62064
		39	3.590	0.66359	1.58639
		40	4.220	0.76727	1.97751
		41	3.570	0.74375	1.58596
		42	4.020	0.77756	1.87500
		43	3.610	0.71063	1.62174
		44	3.550	0.68269	1.60779
		45	3.790	0.67558	1.67329

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TABLE XIX CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - BOTH KIDNEYS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
I-II	1.0	61	3.[illegible]	1.03143	[illegible]8849
		62	2.88[illegible]	0.71193	1.04850
		63	4.000	0.77821	1.75285
		64	3.930	0.72243	1.78555
		65	3.560	0.78761	1.53717
		66	3.740	0.82561	1.72112
		67	3.750	0.84767	1.70145
		68	4.860	0.83649	2.17256
		69	3.700	0.75975	1.72575
		70	4.040	0.73693	1.82395
		71	3.470	0.73987	1.59394
		72	4.430	0.84704	1.94043
		73	3.860	0.78296	1.84424
		74	4.120	0.78476	1.93336
		75	4.340	0.82042	1.98083
I-III	10.0	91	3.710	0.65664	1.62080
		92	3.210	0.59665	1.61958
		93	4.150	0.69514	2.07500
		94	3.330	0.67273	1.47410
		95	3.710	0.74949	1.55948
		96	4.260	0.79330	2.11310
		97	3.580	0.75210	1.63545
		98	3.980	0.72364	1.95098
		99	3.640	0.77944	1.82639
		100	3.810	0.75 95	1.72164
		101	3.770	0.77096	1.75023
		102	3.100	0.59961	1.59465
		103	3.780	0.69485	1.68901
		104	3.960	0.78261	1.83164
		105	4.390	0.78533	2.08948

TABLE XX

TEST MATERIAL - FINEMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BOTH KIDNEYS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	2.220	0.80435	1.17460
		18	2.190	0.69968	1.23589
		20	2.310	0.66571	1.17737
		21	2.210	0.70382	1.28414
		22	2.110	0.77289	1.24045
		23	2.140	0.82946	1.25073
		24	2.160	0.76868	1.18421
		25	1.870	0.83482	1.10065
		26	2.190	0.83270	1.26516
		27	2.360	0.71084	1.35399
		29	2.160	0.67290	1.15323
T-1	0.1	47	1.870	0.74502	1.03201
		48	2.470	0.77918	1.42036
		49	2.020	0.75940	1.16025
		50	1.970	0.70863	1.10241
		51	1.910	0.76707	1.12485
		52	1.760	0.68482	1.04700
		53	2.310	0.78305	1.[illegible]050
		54	2.140	0.68810	1.[illegible]754
		55	2.070	0.71626	1.[illegible]175
		56	2.000	0.67797	1.06553
		57	1.990	0.64821	1.09884
		58	2.240	0.64740	1.23145
		59	2.340	0.84173	1.32728
		60	2.290	0.69817	1.27649

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TABLE XX CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - BOTH KIDNEYS

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	2.300	0.75410	1.25409
		78	2.580	0.72472	1.28936
		79	2.050	0.76779	1.11900
		80	2.460	0.79100	1.48282
		82	2.190	0.70874	1.23450
		83	2.080	0.79693	1.21354
		84	2.330	0.77926	1.27322
		85	2.170	0.75874	1.16729
		86	2.450	0.77532	1.39205
		87	2.160	0.77143	1.26686
		88	2.260	0.69969	1.24655
		89	2.650	0.79819	1.43166
		90	2.530	0.70278	1.44242
T-III	10.0	106	2.330	0.82042	1.25742
		107	2.320	0.85294	1.25950
		108	2.340	0.84783	1.36602
		114	2.160	0.70130	1.23217
		115	2.360	0.83099	1.26474
		116	2.570	0.95185	1.42382
		117	2.350	0.88015	1.33523
		119	2.900	0.90909	1.54420
		120	2.610	0.83654	1.54073

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TABLE XXI

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - LIVER

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	16.520	3.31727	7.52963
		3	21.630	3.62312	9.59627
		5	18.990	3.40934	8.44375
		6	13.210	2.60039	6.01001
		7	15.190	3.39063	6.93607
		8	14.830	3.64373	7.29105
		9	22.850	4.07308	10.59833
		10	18.650	3.24913	8.75998
		11	18.620	3.38545	8.90909
		12	16.510	3.11509	7.17826
		13	19.020	3.52222	9.24198
		14	20.140	3.64195	9.10900
		15	18.210	3.53592	8.25102
T-1	0.1	31	17.780	3.24453	8.11502
		32	16.920	3.15672	7.10327
		33	13.930	2.95127	6.62072
		34	16.830	3.36600	7.93868
		35	18.620	3.92827	8.47519
		36	17.720	3.77021	8.40607
		37	20.670	3.44500	9.05784
		38	17.460	3.49200	7.90403
		39	17.280	3.19409	7.63588
		40	20.180	3.66909	9.45642
		41	19.720	4.10833	8.76055
		42	16.090	3.11219	7.50466
		43	19.860	3.90945	8.92183
		44	17.480	3.36154	7.91667
		45	20.910	3.72727	9.23179

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TABLE XXI CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - LIVER

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	61	13.170	3.76286	6.15996
		62	17.630	3.23486	8.39924
		63	16.550	3.21984	7.25241
		64	17.720	3.25735	8.05089
		65	14.520	3.21239	6.26943
		66	19.850	4.38190	9.13484
		67	17.600	3.03972	7.98548
		68	21.650	3.72633	9.67814
		69	15.140	3.10883	7.06157
		70	18.680	3.42125	8.43341
		71	14.780	3.15139	6.78916
		72	18.570	3.55067	8.13403
		73	16.130	3.27181	7.70664
		74	18.180	3.46286	8.53121
		75	18.540	3.50473	8.46189
T-III	10.0	91	19.480	3.44779	8.51027
		92	17.770	3.30297	8.96569
		93	21.640	3.62479	10.82000
		94	17.840	3.60404	7.89730
		95	18.450	3.72727	7.75536
		96	21.500	4.00372	10.66468
		97	14.510	3.04832	6.62860
		98	16.990	3.08909	8.32843
		99	17.240	3.69165	8.65028
		100	17.570	3.48611	7.93945
		101	16.200	3.31288	7.52089
		102	16.420	3.17602	8.44650
		103	18.060	3.31985	8.06971
		104	16.660	3.29249	7.70583
		105	18.250	3.26476	8.68634

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TABLE XXII

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - LIVER

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	8.250	2.98913	4.36508
		18	9.510	3.03834	5.36682
		20	11.650	3.35735	5.93782
		21	11.400	3.63057	6.62406
		22	9.600	3.51648	5.64374
		23	9.450	3.66279	5.52309
		24	9.100	3.23843	4.98904
		25	7.040	3.14286	4.14361
		26	9.130	3.47148	5.27441
		27	12.210	3.67771	7.00516
		29	11.010	3.42991	5.67827
T-1	0.1	47	7.760	3.09163	4.28256
		48	10.780	3.40063	6.19896
		49	9.090	3.41729	5.22114
		50	9.400	3.38129	5.26021
		51	7.610	3.05622	4.48174
		52	8.650	3.36576	5.14575
		53	10.920	3.70169	6.20455
		54	9.480	3.04823	5.30498
		55	9.500	3.28720	5.23993
		56	9.340	3.16610	4.97603
		57	9.100	2.96417	5.02485
		58	10.020	2.89595	5.50852
		59	11.520	4.14388	6.53432
		60	11.480	3.50000	6.39911

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TABLE XXII CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - LIVER

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	10.550	3.45902	5.75245
		78	12.890	3.62079	6.44178
		79	8.780	3.28839	4.79258
		80	11.780	3.78778	7.10066
		82	10.080	3.26214	5.68207
		83	7.080	2.71264	4.13069
		84	10.290	3.44147	5.62295
		85	9.390	3.28322	5.05110
		86	10.650	3.37025	6.05114
		87	9.990	3.56786	5.85924
		88	10.480	3.24458	5.78047
		89	12.150	3.65964	6.56402
		90	11.120	3.08809	6.33979
T-III	10.0	106	10.810	3.80634	5.83378
		107	10.360	3.80882	5.62432
		108	11.080	4.01449	6.46818
		114	10.270	3.33442	5.85853
		115	10.280	3.61972	5.50911
		116	11.840	4.38519	6.55956
		117	10.550	3.95131	5.99432
		119	10.440	3.27273	5.55911
		120	11.880	3.80769	7.01299

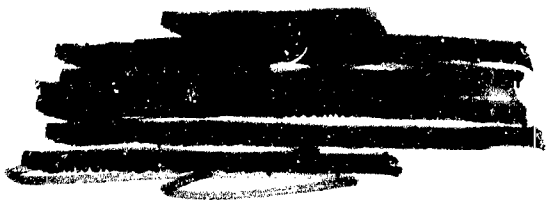

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TABLE XXIII

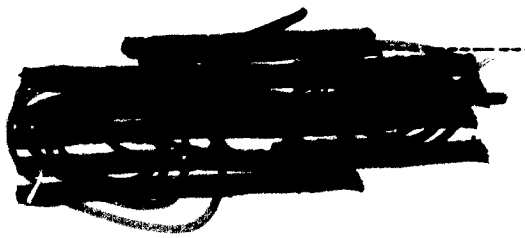
TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

ORGAN WEIGHT DATA - SPLEEN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	1	0.670	0.13454	0.30538
		3	0.880	0.14740	0.39042
		5	0.890	0.15978	0.39573
		6	0.870	0.17126	0.39581
		7	0.790	0.17634	0.36073
		8	0.800	0.19656	0.39331
		9	0.910	0.16221	0.42208
		10	0.750	0.13066	0.35228
		11	0.780	0.14182	0.37321
		12	0.870	0.16415	0.37826
		13	0.780	0.14444	0.37901
		14	0.740	0.13382	0.33469
		15	0.660	0.12816	0.29905
T-1	0.1	31	0.690	0.12591	0.31492
		32	0.780	0.14552	0.32746
		33	0.840	0.17797	0.39924
		34	1.010	0.20200	0.47642
		35	0.650	0.13713	0.29586
		36	0.580	0.12340	0.27514
		37	1.000	0.16667	0.43821
		38	0.770	0.15400	0.34857
		39	0.770	0.14233	0.34026
		40	1.310	0.23818	0.61387
		41	0.880	0.18333	0.39094
		42	0.820	0.15861	0.38246
		43	0.910	0.17913	0.40881
		44	0.730	0.14038	0.33062
		45	1.010	0.18004	0.44592



[redacted]

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0504

TABLE XXIII CONTINUED

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

INAL SACRIFICE - MALES

ORGAN WEIGHT DATA - SPLEEN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	61	1.440	0.41143	0.67353
		62	1.090	0.20000	0.51929
		63	0.780	0.15175	0.34181
		64	0.830	0.15257	0.37710
		65	0.690	0.15265	0.29793
		66	0.900	0.19868	0.41417
		67	0.710	0.12263	0.32214
		68	0.970	0.16695	0.43362
		69	0.770	0.15811	0.35914
		70	0.870	0.15934	0.39278
		71	0.760	0.16205	0.34910
		72	0.760	0.14532	0.33290
		73	0.790	0.16024	0.37745
		74	0.660	0.12571	0.30971
		75	0.790	0.14934	0.36057
T-III	10.0	91	0.810	0.14336	0.35387
		92	0.780	0.14498	0.39354
		93	0.930	0.15578	0.46500
		94	0.990	0.20000	0.43825
		95	0.900	0.18182	0.37831
		96	0.980	0.18250	0.48611
		97	1.020	0.21429	0.46597
		[illegible]	0.820	0.14909	0.40196
		[illegible]	0.690	0.14775	0.34621
		[illegible]	0.840	0.16667	0.37958
		[illegible]	0.650	0.13292	0.30176
		102	0.790	0.15280	0.40638
		103	1.010	0.18566	0.45130
		104	0.810	0.16008	0.37465
		105	0.850	0.15206	0.40457

[redacted]

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TABLE XXIV

TEST MATERIAL - FIREMASTER® 680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - SPLEEN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
C	0	17	0.530	0.19203	0.28042
		18	0.640	0.20447	0.36117
		20	0.520	0.14986	0.26504
		21	0.490	0.15605	0.28472
		22	0.500	0.18315	0.29394
		23	0.420	0.16279	0.24547
		24	0.470	0.16726	0.25768
		25	0.560	0.25000	0.32961
		26	0.480	0.18251	0.27730
		27	0.630	0.18976	0.36145
		29	0.530	0.16511	0.28297
T-1	0.1	47	0.400	0.15936	0.22075
		48	0.600	0.18927	0.34503
		49	0.420	0.15789	0.24124
		50	0.460	0.16547	0.25741
		51	0.490	0.19679	0.28857
		52	0.470	0.18288	0.27960
		53	0.600	0.20339	0.34091
		54	0.460	0.14791	0.25741
		55	0.500	0.17301	0.27579
		56	0.470	0.15932	0.25040
		57	0.460	0.14284	0.25400
		58	0.610	0.17630	0.33535
		59	0.470	0.16906	0.26659
		60	0.720	0.21951	0.40134

Industrial BIO-TEST Laboratories, Inc.

TABLE XXIV CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

ORGAN WEIGHT DATA - SPLEEN

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	ORGAN WEIGHT (G)	ORGAN/BODY WEIGHT RATIO (G/100 G)	ORGAN/BRAIN WEIGHT RATIO (G/G)
T-II	1.0	76	0.610	0.20000	0.33261
		78	0.590	0.16573	0.29485
		79	0.460	0.17228	0.25109
		80	0.530	0.17042	0.31947
		82	0.490	0.15858	0.27621
		83	0.490	0.18774	0.28588
		84	0.490	0.16388	0.26776
		85	0.460	0.16084	0.24744
		86	0.560	0.17722	0.31818
		87	0.530	0.18929	0.31085
		88	0.420	0.13003	0.23166
		89	0.580	0.17470	0.31334
		90	0.630	0.17500	0.35918
T-III	10.0	106	0.610	0.21479	0.32920
		107	0.550	0.20221	0.29859
		108	0.490	0.17754	0.28605
		114	0.450	0.14610	0.25670
		115	0.530	0.18662	0.28403
		116	0.630	0.23333	0.34903
		117	0.470	0.17603	0.26705
		119	0.610	0.19122	0.32481
		120	0.660	0.21154	0.38961

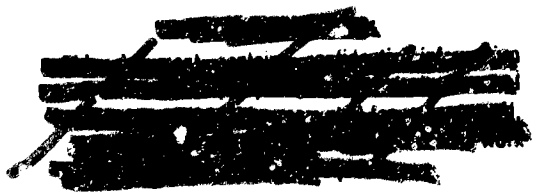

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TABLE XXV

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

FINAL BODY WEIGHT DATA

MRC 038

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	BODY WEIGHT (G)
C	0	1	498.000
		3	597.000
		5	557.000
		6	508.000
		7	448.000
		8	407.000
		9	561.000
		10	574.000
		11	550.000
		12	530.000
		13	540.000
		14	553.000
		15	515.000
T-I	0.1	31	548.000
		32	536.000
		33	472.000
		34	500.000
		35	474.000
		36	470.000
		37	600.000
		38	500.000
		39	541.000
		40	550.000
		41	480.000
		42	517.000
		43	508.000
		44	520.000
		45	561.000

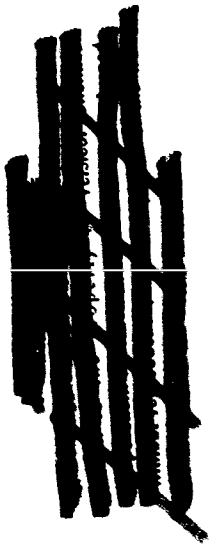

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TABLE XXV CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - MALES

FINAL BODY WEIGHT DATA

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	BODY WEIGHT (G)
T-II	1.0	61	350.000
		62	545.000
		63	514.000
		64	544.000
		65	452.000
		66	453.000
		67	579.000
		68	581.000
		69	487.000
		70	546.000
		71	469.000
		72	523.000
		73	493.000
		74	525.000
		75	529.000
T-III	10.0	91	565.000
		92	538.000
		93	597.000
		94	495.000
		95	495.000
		96	537.000
		97	476.000
		98	550.000
		99	467.000
		100	504.000
		101	489.000
		102	517.000
		103	544.000
		104	506.000
		105	559.000

TABLE XXVI

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

FINAL BODY WEIGHT DATA

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GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	BODY WEIGHT (G)
C	0	17	276.000
		18	313.000
		20	347.000
		21	314.000
		22	273.000
		23	258.000
		24	281.000
		25	224.000
		26	263.000
		27	332.000
		29	321.000
T-I	0.1	47	251.000
		48	317.000
		49	266.000
		50	278.000
		51	249.000
		52	257.000
		53	295.000
		54	311.000
		55	289.000
		56	295.000
		57	307.000
		58	346.000
		59	278.000
		60	328.000

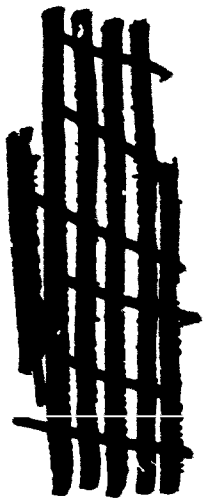

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TABLE XXVI CONTINUED

TEST MATERIAL - FIREMASTER®680

90-DAY SUBACUTE ORAL TOXICITY STUDY - ALBINO RATS

FINAL SACRIFICE - FEMALES

FINAL BODY WEIGHT DATA

GROUP	DIETARY LEVEL PERCENT	ANIMAL NUMBER	BODY WEIGHT (G)
T-II	1.0	76	305.000
		78	356.000
		79	267.000
		80	311.000
		82	309.000
		83	261.000
		84	299.000
		85	286.000
		86	316.000
		87	280.000
		88	323.000
		89	332.000
		90	360.000
T-III	10.0	106	284.000
		107	272.000
		108	276.000
		114	308.000
		115	284.000
		116	270.000
		117	267.000
		119	319.000
		120	312.000

88-7800184

VELSICOL CHEMICAL CORPORATION
741 EAST OHIO STREET · CHICAGO, ILLINOIS 60611 · 312-670-4500

SC 11/04/

October 28, 1977

PAGE 0003

Assistant Administrator
Office of Toxic Substances
U.S. Environmental Protection Agency
Waterside Mall
Washington, D.C. 20460

Re: MC-984, Velsicol's name for a product whose primary constituent is Bis(1,3-dichloro-2-propyl)-3-chloro-2,2-dibromomethyl-1-propyl phosphate ( )

Dear Sir:

The attached documents are submitted for your files and in compliance with section 8(e) of TSCA, if the latter is necessary.

For the record, these documents are identified as follows:

1. Memo from M. S. Root to D. M. Whitacre, re Mutagenicity Evaluation of MC 984; Mouse Lymphoma Assay Final Report, October 5, 1977.

2. "Mutagenicity Evaluation of MC 984 in the Mouse Lymphoma Assay Final Report", LBI Project No. 20839, August, 1977.

We make no judgment that these documents contain adverse information. We reserve our right to contest the propriety of section 8(e) of TSCA.

Sincerely,

VELSICOL CHEMICAL CORPORATION

Thomas R. Loy
Manager,
Regulatory Activities
Environmental Sciences and
Regulatory Activities

TRL:eh
Enclosure

23

0512

Oct. 5, 1977

D. M. Whitacre	3322	C. J. Calo	3322
		H. V. Davis	5460
		T. R. Loy	3322
		A. A. Levin	4660
		F. A. Daniher	0714
M. S. Root	3309	M. S. Root	3309

Mutagenicity Evaluation of MC 984; Mouse Lymphoma Assay Final Report

PAGE 0004

A final report has just been received (09/15/77) in which the genetic activity of MC 984 was evaluated in the forward mutation mouse lymphoma assay.

MC 984 induced a weak mutagenic response at the TK locus of the L 5178Y Mouse Cell both in the presence and absence of mouse lymphoma activation under the conditions of this assay. This compound however, was toxic to the cells and produced a cloudy suspension when added at the two higher concentrations (0.08 l/ml and 0.16 l/ml). While this finding may indicate mugenicity, one could conclude that it may also be due to an artifact. However, the laboratory responsible for this study has indicated, in their estimation, that the effect was mutagenic.

By copy of this memo I am advising T. R. Loy that photocopies of this report are available for submission to appropriate regulatory files.

Mildred S. Root

MSR/jh

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88-7800184

8EHQ-0678-0184

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MUTAGENICITY EVALUATION
OF
MC 984
IN THE MOUSE LYMPHOMA ASSAY
FINAL REPORT

SUBMITTED TO

VELSICOL CHEMICAL CORPORATION
341 EAST OHIO STREET
CHICAGO, ILLINOIS 60611

SUBMITTED BY

LITTON BIONETICS, INC.
5516 NICHOLSON LANE
KENSINGTON, MARYLAND 20795

LBI PROJECT NO. 20839

AUGUST, 1977

Declassified
8-22-78

Litton BIONETICS

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[redacted]

EVALUATION SUMMARY

The test compound, MC 984, was evaluated as inducing weak but significant genetic activity at the TK locus in L5178Y cells.

MM0024

Litton BIONETICS

[redacted]

0.5.16

SPONSOR: Velsicol Chemical Corporation

MATERIAL: MC 984

SUBJECT: FINAL REPORT L5178Y MOUSE LYMPHOMA MUTAGENICITY ASSAY

1. OBJECTIVE

The objective of this study was to evaluate MC 984 for specific locus forward mutation induction in the L5178Y Thymidine Kinase (TK) mouse lymphoma cell assay.

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2. MATERIALS

A. Test Compound

1. Date Received: February 4, 1977

2. Description: Amber viscous liquid

B. Indicator Cells

The Fischer mouse lymphoma cell line used in this study was derived from L5178Y. The cells are heterozygous for a specific autosomal mutation at the TK locus and are bromodeoxyuridine (BUdR) sensitive. Scoring for mutation was based on selecting cells that have undergone forward mutation from a TK+/- to a TK-/- genotype by cloning them in soft agar with BUdR.

C. Media

The cells were maintained in Fischer's Medium for Leukemic Cells of Mice with 10% horse serum and sodium pyruvate. Cloning medium consisted of Fischer's medium with 20% horse serum, sodium pyruvate, and 0.37% agar. Selection medium was made from cloning medium by the addition of 5.0 mg of BUdR to 100 ml of cloning medium.

D. Control Compounds

1. Negative Control

The solvent in which the test compound was dissolved was used as a negative control and is designated as solvent control in the data table. The actual solvent is listed in the Results Section.

2. MATERIALS (Continued)

D. Control Compounds

2. Positive Controls

Ethylmethanesulfonate (EMS), which induces mutation by base-pair substitution, was dissolved in culture medium and used as a positive control for the nonactivation studies at a final concentration of 0.5 µl/ml.

Dimethylnitrosamine (DMN), which requires metabolic biotransformation by microsomal enzymes, was used as a positive control substance for the activation studies at a final concentration of 0.3 µl/ml.

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3. EXPERIMENTAL DESIGN

A. Toxicity

The solubility, toxicity, and doses for all chemicals were determined prior to screening. The effect of each chemical on the survival of the indicator cells was determined by exposing the cells to a wide range of chemical concentrations in complete growth medium. Toxicity was measured as loss in growth potential of the cells induced by a four-hour exposure to the chemical followed by a 24-hour expression period in growth medium. A minimum of four doses was selected from the range of concentration by using the highest dose that showed no loss in growth potential as the penultimate dose and by bracketing this with one higher dose and at least two lower doses. Toxicity produced by chemical treatment was monitored during the experiment.

B. Assays

1. Nonactivation Assay

The procedure used is a modification of that reported by Clive and Spector (Mutation Research, 31:17-29, 1975). Prior to each treatment, cells were cleansed of spontaneous TK-/- by growing them in a medium containing thymidine, hypoxanthine, methotrexate, and glycine (THMG). This medium permits the survival of only those cells that produce the enzyme thymidine kinase, and can therefore utilize the exogenous thymidine from the medium. The test compound was added to the cleansed cells in growth medium at the predetermined doses for four hours. The mutagenized cells were washed, fed, and allowed to express in growth medium for three days. At the end of this expression period, TK-/- mutants were detected by cloning the cells in the selection medium for ten days. Surviving cell populations were determined by plating diluted aliquots in nonselective growth medium.

3. EXPERIMENTAL DESIGN (Continued)

B. Assays

2. Activation Assay

The activation assay differs from the nonactivation assay in the following manner only. Two milliliters of the reaction mixture were added to 10 ml of growth medium. The desired number of cleansed cells was added to this mixture, and the flask was incubated on a rotary shaker for four hours. The incubation period was terminated by washing the cells twice with growth medium. The washed mutagenized cells were then allowed to express for three days and were cloned as indicated for the nonactivated cells.

C. Preparation of 9,000 x g Supernatant

Male random bred mice were killed by cranial blow, decapitated, and bled. The liver was immediately dissected from the animal using aseptic technique and placed in ice-cold 0.25M sucrose buffered with Tris buffer at a pH of 7.4. When an adequate number of livers had been collected, they were washed twice with fresh buffered sucrose and completely homogenized. The homogenate was centrifuged for 20 minutes at 9,000 x g in a refrigerated centrifuge. The supernatant from this centrifuged sample was retained and frozen at -80C until used in the activation system. This microsome preparation was added to a "core" reaction mixture to form the activation system described below:

Component	Final Concentration/ml
1. TPN (sodium salt)	6 µmoles
2. Isocitric acid	35 µmoles
3. Tris buffer, pH 7.4	28 µmoles
4. $MgCl_2$	2 µmoles
5. Homogenate fraction equivalent to 25 mg of wet tissue	

D. Screening

A mutation index was derived by dividing the number of clones formed in the BUdR-containing selection medium by the number found in the same medium without BUdR. The ratio was then compared to that obtained from other dose levels and from positive and negative controls. Colonies were counted on an electronic colony counter that resolves all colonies greater than 200 microns in diameter.

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4. RESULTS

The data presented in the following table show the concentrations of the test compound employed, the number of mutant clones obtained, the surviving populations after the expression period, and the calculated mutation frequencies.

[redacted]

4.__SUMMARY_OF_MOUSE_LYMPHOMA_ASSAY_RESULTS

LITTON BIONETICS, INC.

A. NAME OR CODE DESIGNATION OF THE TEST COMPOUND: NC 984

B. SOLVENT: DMSO
C. TEST DATE: JULY 18, 1977
NOTE: CONCENTRATIONS ARE GIVEN IN MICROLITERS (UL) OR MICROGRAMS (UG) OR NANOLITERS(NL) PER MILLILITER.

TEST	S-9 TISSUE	S-9 SOURCE	DAILY COUNTS (CELLS/ML X 10E5) 1	2	3	RELATIVE SUSPENSION GROWTH (% OF CONTROL)	MUTANT CLONES	VIABLE CLONES	RELATIVE CLONING EFFICIENCY (% OF CONTROL)	PERCENT RELATIVE GROWTH*	MUTANT FREQUENCY** (X 10E-6)
NONACTIVATION											
SOLVENT CONTROL	---	---	11.5	13.5	11.6	100.0	31.0	336.0	100.0	100.0	0.0923
NEGATIVE CONTROL	---	---	10.6	8.6	12.2	61.8	16.0	394.0	117.3	72.5	0.04
EMS .5UL/ML	---	---	5.0	13.0	9.6	34.6	385.0	119.0	35.4	12.3	3.2353
TEST COMPOUND											
0.01000 UL/ML	---	---	7.0	15.0	9.8	57.1	28.0	318.0	94.6	54.1	0.0881
0.02000 UL/ML	---	---	6.8	11.2	10.2	43.1	44.0	346.0	103.0	44.4	0.1272
0.04000 UL/ML	---	---	2.6	5.2	8.4	7.4	52.0	342.0	101.8	7.5	0.1520
0.08000 UL/ML	---	---	2.8	2.6	9.8	4.9	64.0	336.0	100.0	4.9	0.1905
0.16000 UL/ML	---	---	0.4 *	2.4 *L	5.4 *	2.6	69.0 *L	174.0	51.8	1.3	0.3966
ACTIVATION											
SOLVENT CONTROL	MOUSE	LIVER	9.2	15.5	9.0	100.0	19.0	316.0	100.0	100.0	0.0601
NEGATIVE CONTROL	MOUSE	LIVER	7.6	15.0	10.4	92.4	23.0	352.0	111.4	102.9	0.0653
DMN .3UL/ML	MOUSE	LIVER	6.0	8.0	11.4	46.9	180.0	163.0	51.6	24.2	1.1043
TEST COMPOUND											
0.01000 UL/ML	MOUSE	LIVER	5.4	17.4	8.6	63.8	32.0	288.0	91.1	57.4	0.1111
0.02000 UL/ML	MOUSE	LIVER	8.6	14.0	7.8	73.2	40.0	329.0	104.1	76.2	0.1216
0.04000 UL/ML	MOUSE	LIVER	8.2	7.4	11.8	55.8	39.0	266.0	84.2	47.0	0.1466
0.08000 UL/ML	MOUSE	LIVER	2.0	6.2	8.2	12.0	80.0	297.0	94.0	11.3	0.2694
0.16000 UL/ML	MOUSE	LIVER	0.6 *	2.0 *	3.2 *	2.0	68.0 *L	338.0 L	107.0	2.2	0.2012

* (RELATIVE SUSPENSION GROWTH X RELATIVE CLONING EFFICIENCY) / 100
** (MUTANT CLONES / VIABLE CLONES) X 10E-6

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5. INTERPRETATION OF RESULTS AND CONCLUSIONS

The test compound, MC 984, was evaluated for genetic activity in the L5178Y mouse lymphoma cell line. The genotype of this cell line is TK+/- and will detect forward mutation to TK-/- cells that are resistant to BUdR. The following results were obtained:

A. Solubility and Toxicity Results

The test compound, MC 984, was dissolved in DMSO at 16 µl/ml. This stock solution was serially diluted in two-fold steps to provide working solutions. The final concentration was achieved by adding 0.1 ml of the stock solution or one of the working solution to 10 ml of growth medium containing the cells. Cloudiness was observed at final concentrations of 0.16 µl/ml and 0.08 µl/ml. This cloudiness persisted throughout the four-hour exposure period but was removed by washing.

Cytotoxicity was monitored by daily cell counts and pH changes (growth) and by microscopic observations on the cells.

Dose-related toxicity was observed both with and without activation (see day 1 counts) and was complete at 0.32 mg/ml and higher.

B. Control Compound Results

DMSO (1%) was used as the solvent control. No genetic effects were attributed to DMSO. The negative control consisted of the test system minus the solvent.

The known mutagens EMS and DMN gave positive responses within the expected range.

C. Test Chemical Results

The mutant frequency for both nonactivation and activation tests showed a dose-related increase up to 4.4 times the solvent control frequency for nonactivation test conditions and 4.5 times the solvent control frequency for activation test conditions. Similarly, there was a two- to three-fold increase in the absolute number of mutants with increasing dose. These observations are suggestive of a mutagenic response.

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5. INTERPRETATION OF RESULTS AND CONCLUSIONS (Continued)

D. Conclusions

The test compound, MC 984, showed a weak but consistent dose-related increase in mutation frequency for all concentrations in the nonactivation test and all except the high dose in the activation test.

By the criteria used to evaluate mutagenicity in this assay, MC 984 was concluded to be weakly mutagenic.

PAGE 0036

Submitted by:

Dale Mathews 9/8/77

David J. Brusick, Ph.D. Date
Director
Department of Genetics
and Cell Biology

Reviewed by:

Robert J. Weir 9/9/77

Robert J. Weir, Ph.D. Date
Vice President

[redacted]

6. CRITERIA USED IN THE EVALUATION

Several criteria have been established which, if met, provide a basis for declaring a material genetically active in the Mouse Lymphoma Assay. These criteria are derived from a historical data base and are helpful in maintaining uniformity in evaluations from material to material and run to run. While these criteria are reasonably objective, a certain amount of flexibility may be required in making the final evaluation since absolute criteria may not be applicable to all biological data.

A compound is considered mutagenic in the Mouse Lymphoma Assay if:

a. A dose response relationship is observed over three of the four dose levels employed.

b. The minimum increase at the high level of the dose response curve is at least 2.5 times greater than the solvent control value.

c. The solvent control data are within the normal range of the spontaneous background for the TK locus.

All evaluations of mutagenic activity are based on the concurrent solvent control value run with the experiment in question. Positive control values are not used as reference points, but are included to ensure the current cell population responds to direct and promutagens under the appropriate treatment conditions.

Occasionally, a single point within a concentration range will show an increase 2.5 times greater than the spontaneous background. If the increase is at the high dose, is reproducible, and if an additional higher dose level is not feasible because of toxicity, the chemical can be considered mutagenic. If the increase is internal within the dose range and is not reproducible, the increase will normally be considered aberrant. If the internal increase is reproducible, several doses clustered around the positive concentration will be examined to either confirm or reject the reliability of the effect.

As the data base on the assay increases, the evaluation criteria can be expected to become more firmly established.

PAGE 0037

88-7800184

8EHQ-0678-0184

25 APR 1978

MAR 0000

Mr. Thomas R. Loy
Manager, Regulatory Activities
Velsicol Chemical Corporation
341 East Ohio Street
Chicago, IL 60611

Dear Mr. Loy:

REFERENCE: SUBMISSIONS PURSUANT TO TSCA SECTION 8(e)

Many of the 8(e) submissions offered by Velsicol lack a clear distinction between those materials submitted with and without claim of confidentiality. According to Section X of the "Statement of Interpretation and Enforcement Policy; Notification of Substantial Risk" published on March 16, 1978 (43 FR 11113):

> (c) To assert a claim of confidentiality for information contained in a notice, the submitter must submit two copies of the notice.
>
> (1) One copy must be complete. In that copy the submitter must indicate what information, if any, is claimed as confidential by marking the specified information on each page with a label such as "confidential," "proprietary," or "trade secret."
>
> (2) If some information in the notice is claimed as confidential, the submitter must submit a second copy. The second copy must be complete except that all information claimed as confidential in the first copy must be deleted.

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Any information received from Velsicol which is not submitted in the above prescribed fashion will be treated as a non-confidential submission. Please keep in mind that under Section 14(b) of TSCA, "data from health and safety studies" is not entitled to confidential treatment, except to the extent that disclosure of such data would reveal either the portion of a mixture comprised of any of the chemical substances in the mixture or the processes used in manufacturing or processing a chemical substance or mixture. Any claim of confidentiality for data from health and safety studies that goes beyond these two types will be denied.

Sincerely,

Warren R. Muir, Ph.D.
Deputy Assistant Administrator
for Testing and Evaluation

PAGE 0009

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8440-0678-0184

88-7800184

7-12-78

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

PAGE 0013

Mr. Thomas R. Loy
Manager, Regulatory Activities
Velsicol Chemical Corp.
341 East Ohio Street
Chicago, IL 60611

Dear Mr. Loy:

On various dates you submitted information (see attached listing of submissions) under the provisions of section 8(e) of the Toxic Substances Control Act (TSCA). You indicated that some of the information in your submission is considered confidential.

The Environmental Protection Agency (EPA) has been receiving many requests for access to notices submitted to EPA under section 8(e) of TSCA. Accordingly, EPA must make a final confidentiality determination concerning the treatment of the information in your submissions. In order to make that determination, EPA needs further information from you. Under EPA's regulations on the treatment of information claimed as confidential in 40 CFR Part 2 (41 FEDERAL REGISTER 36902, September 1, 1976), you have an opportunity to submit comments to substantiate your claim of confidentiality.

To comply with these requirements, you must indicate which portions of your submissions are claimed as confidential. Be specific as to page, paragraph, or sentence as appropriate. For those portions that you identify as confidential, you must address the following questions. In answering the questions, be as specific as possible, give examples if necessary, and connect the specific answers to the specific claimed portions.

1. For how long a period do you desire confidential treatment? May EPA disclose this information after a certain date or after the occurrence of a specific event?

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2. What measures have you taken to guard against undesired disclosure of this information to others?

3. To what extent have you disclosed this information to others, and what precautions have you taken in connection with the disclosures to protect against further disclosure?

4. Have there been any confidentiality determinations made by EPA, other federal agencies, or courts in connection with this information? If so, please enclose copies.

5. Do you assert that disclosure of this information would be likely to result in substantial harm to your competitive position? If so, what are those harmful effects, and why should they be regarded as substantial? What is the causal relationship between the disclosure and the harmful effects?

6. Do you assert that this information was voluntarily submitted as defined in 40 CFR 2.201(i)? If so, would the disclosure of this information tend to lessen the availability to the Government of similar information in the future? Why?

In making your claims of confidentiality and providing responses to the above questions, you should keep in mind that under section 14(b) of TSCA, "data from health and safety studies" is not entitled to confidential treatment, except to the extent that disclosure of such data would reveal either the portion of a mixture comprised of any of the chemical substances in the mixture or the processes used in manufacturing or processing a chemical substance or mixture. Any claim of confidentiality for data from health and safety studies that goes beyond these two types will be denied.

In responding, please reference the following document control number and address your response to:

OTS Document Control Officer
Environmental Protection Agency
Office of Toxic Substances (TS-793)
401 M Street, S.W.
Washington, DC 20460

Your comments must be received by EPA not later than the 15th day (Saturdays, Sundays, and federal holidays excluded) after the date on which you receive this certified letter. Failure to submit comments within that period will be treated by EPA as a waiver or withdrawal of your request

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for confidential treatment, and the information will be made available to the public without further notice to you. You may request an extension of time for submitting your comments by contacting the Document Control Officer; however, extensions will not be granted, except in extraordinary circumstances. You will be notified of EPA's confidentiality determination 30 days prior to any disclosure.

If the information you submit to EPA in making your comments about your confidentiality claim is not otherwise possessed by EPA and is marked with a designation such as "trade secret," "company confidential," or other appropriate label, it will be regarded by EPA as entitled to confidential treatment and will not be disclosed without your consent unless its disclosure is ordered by a Federal court.

For your use in considering future submissions, a copy of the "Policy Statement on Notification of Substantial Risk Under Section 8(e) of the Toxic Substances Control Act" will be forwarded following its publication in the Federal Register.

Very truly yours,

/s/

Joyce A. Barbour
OTS Document Control Assistant

PAGE 0015

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	Date	Submission	Document Control No.
(1)	6/13/78	Firemaster 680 (Benzene, 1, 1-(1, 1/2- Ethanediylbis (OXY) Bis (2,4,6, Tribromo	8EHQ-0678-0184C
(2)	6/9/78	Firemaster PMT4, (Tetrabromo Bisphenol A, CAS# 79-94-7)	8EHQ-0678-0185C
(3)	6/13/78	TRIS, also called Firemaster T23P, CAS #126-72-7; and DBCP, also called Propane, 1,2-Dibromo-3-Chloro-, CAS #96-12-8	8EHQ-0678-0192C

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closure of this information to others?

8EHQ-0878-0184

88-7800184

VELSICOL CHEMICAL CORPORATION

241 EAST OHIO STREET • CHICAGO, ILLINOIS 60611 • 312-670-4500

August 22, 1978

PAGE 0017

RECEIVED
31 AUG

Ms. Joan Urquhart
OTS Document Control Officer
U.S. EPA
OTS (TS-793)
401 M Street S.W.
Washington, D.C. 20460

Re: Document Control Numbers
8EHQ-0678-0184C
8EHQ-0678-0185C
8EHQ-0678-0192C

Dear Ms. Urquhart

In your recent undated letter you requested that we substantiate the confidentiality which was claimed in several recent submissions.

Conc[illegible] the documents identif[illegible] 8EHQ-0678-0184C [illegible] 8EH[illegible]-0185C, Velsicol hereby [illegible] its claims of [illegible]fidenti[illegible] on those items. Such [illegible] is not to be construed as a [illegible] or estoppel to [illegible] of confiden[illegible]ity on a[illegible] piece of informat[illegible] similar in na[illegible] to any [illegible] above.

If [illegible] further quest[illegible] this matter [illegible]se contact [illegible] (312) 670-4764.

[illegible]

[illegible] CHEMICAL CORP[illegible]ION

[illegible]

[illegible]as R. Loy
[illegible]ager,
[illegible]els and Petitions

at

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0531

CERTIFICATE OF AUTHENTICITY

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Marcia Tubolino
Camera Operator

Place Syracuse (City) New York (State)

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