

M E M O R A N D U M

To: Members - OSHA Sub-Committee
(See Attached Distribution List)

Date: May 15, 1974

From: A. B. Steele

Subject: Preliminary Draft of Statement
on Monomer Exposure and Health
Experience of Workers in Plants
Polymerizing Vinyl Chloride

With the help of Messrs. D. A. Rausch (Dow) and Daniel Dixler (Keller and Heckman) we have drafted a position paper oriented toward the health experience of workers and technicians in the 36 PVC plants where workers have been exposed to significant concentrations of vinyl chloride in the workplace air over an extended period of time - exposed to concentrations of vinyl chloride well in excess of the limits now imposed on the industry by the temporary OSHA standard of 50 ppm ceiling level. Specific case studies have been selected to document the past and present levels of VCM exposure and to support the view that VCM exposure levels have tended sharply downward in the past years. Coupled with the results of the Tabershaw/Cooper study and the survey of worker health now being compiled by Dr. Dernehl, the actual experience tends to support the conclusion that there is no significant impairment of health to workers exposed to restricted amounts of vinyl chloride for extended time periods or exposed to high concentrations for short periods.

Your comments on additions, revision, or modification of the draft will be most welcome.



A. B. Steele
For the Sub-Committee

ABS:ml
Attachment

STATEMENT OF PVC PRODUCERS IN THE UNITED STATES RELATIVE TO HEALTH
EXPERIENCE OF WORKERS IN PLANTS POLYMERIZING VINYL CHLORIDE

SUMMARY

The Department of Labor has imposed major restrictions on the exposure levels of workers in the VCM and PVC industry based on a possible connection between vinyl chloride exposure and deaths of a limited number of workers of angiosarcoma--a rare form of liver cancer. The Department's regulation on vinyl chloride limits in the workplace air is based, in part, on the findings of several scientists that report vinyl chloride exposure in mice and rats caused cancer.

Because animal data are unreliable in measuring impact on man unless the test animal and man have been shown to have similar metabolisms and since such data have indicated a hazard from vinyl chloride exposure far greater than that generally experienced by workers and technicians in individual vinyl chloride monomer and polymer plants, a study was initiated to determine the actual experience in all operating plants within the United States where workers have been exposed to significant concentrations of vinyl chloride in the workplace air over extended periods of time. Reconstructions of past frequencies and levels of vinyl chloride exposure have been correlated with recent and current experience in 36 plants manufacturing PVC resins. The health status of individual workers has been determined by extensive medical examination; cause of death of all PVC workers has been tabulated. Based on these evidences, we conclude:

- that there is no significant impairment of health to workers exposed to restricted amounts of vinyl chloride monomer for extended time periods.
- that exposures to high concentrations for short periods do not impair health; high concentrations being at or above the odor level of 250 - 300 ppm.

- that an eight-hour time-weighted average (TWA) of 50 ppm represents a realistic exposure limit; at higher levels respiratory protection is appropriate.

RELEVANCY OF ANIMAL TOXICITY DATA

Extrapolation of animal toxicity data directly to man is fraught with gross uncertainty without prior knowledge of the manner in which man metabolizes the compound. Thus, in the case of vinyl chloride monomer, the finding of angiosarcomas in mice and rats cannot be considered pertinent to man until it is demonstrated that rodents metabolize vinyl chloride in a manner and at a rate similar to man. While methods have been established for the determination of metabolites in man and rodents ⁽¹⁾, such experimental procedures have yet to be applied to vinyl chloride, leaving in serious doubt the relevancy of the animal test data that is used to brand vinyl chloride a carcinogen.

Because vinyl chloride is a carcinogen for rats and presumably even a more potent one for mice does not mean that the same rapid induction can or will occur in man. The evidence provided by the industry survey ⁽²⁾ in itself is evidence that very few men have been involved to date...Witness more than thirty years of manufacturing experience with only limited cases of angiosarcoma among more than 1500 workmen variously exposed for 15 years or more. Additionally, no case should be charged solely to vinyl chloride exposure if the victim has a history of exposure to other chemicals.

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- (1) In vitro vs in vivo chromatographic profiles of Carbaryl anionic metabolites in man and lower animals. Sullivan, L. J., B. H. Chin and C. P. Carpenter. Tox. Appl. Pharm. 22: 161-174 (1972).
 - (2) EPIDEMIOLOGICAL STUDY OF VINYL CHLORIDE WORKERS - FINAL REPORT - May 3, 1974: Tabershaw-Cooper Associates, Berkeley, Calif. for Manufacturing Chemists Association.

LEVELS OF VINYL CHLORIDE EXPOSURE IN PVC OPERATIONS

Experience within the PVC industry generally has shown that workers exposed to vinyl chloride have maintained health status comparing favorably to that of workers in other chemical and resin operations and to other industrial populations, yet the PVC workers have been exposed to significant concentrations of vinyl chloride in the workplace air over extended periods of time-- exposed to concentrations of vinyl chloride well in excess of the limits now imposed on the industry by the present temporary OSHA standard of 50 ppm ceiling level. Attempts to quantify the levels of exposure to which workmen were subjected in past years on each job and in each plant had to be abandoned; reliable measurements of vinyl chloride levels in the workplace air over extended periods of time are generally not available. However, careful examination of certain plants and of operating data has provided insight into the vinyl chloride exposure levels of workmen in specific assignments. Case studies have been documented and support the view that there is no discernible impairment to health of workers exposed to restricted amounts of vinyl chloride for extended time periods and to high concentrations for short periods:

CASE STUDY-VCM EXPOSURE IN PVC SOLVENT POLYMERIZATION OPERATIONS

The Solvent Process as operated by Union Carbide has remained essentially unchanged as to process, recipe, equipment and operating procedures since about 1951. It is the testimony of those closely associated with the plant operation that vinyl chloride emissions are presently of the same order of magnitude in the Solvent polymer plant as has been experienced regularly over the past twenty years; that measurements of vinyl chloride monomer in the workplace air and of exposure of operators to monomer made recently are representative of the continuing condition since 1953; a condition within which significant and frequent excursions beyond the 50 ppm ceiling standard were experienced as determined by detection of vinyl chloride by odor level (250 - 300 ppm VCM assumed as the odor threshold).

Recent determinations (January and February, 1974) identified the following VCM exposures to operators in the polymerization section of the plant:

<u>Operator Number</u>	<u>Time Weighted Average - 8 Hour</u>
1.	16.9
2.	9.8
3.	23.6
4.	3.5
5.	4.8
6.	21.3

One of the tasks assigned to these operators is the taking and testing of autoclave samples to determine degree of conversion. During sampling and testing, which occurs four times each shift and requires about eight minutes to complete the task, workplace environmental levels range as high as 400 ppm

in the sampling area.

Exposure time has been gathered on all employees working this job at the Texas City plant from 1948 to the present. There were 53 such employees; 24 had more than 1 year work experience on this job; 2 employees had 12 years of exposure. None shows any liver abnormalities, based on recent medical evidence. At South Charleston where a similar line is operated with almost identical exposure levels, a similar breakdown on operators is not available due to differences in job dynamics. Nevertheless, health of PVC workers is statistically similar to that of other workers in the same plant and no case of angiosarcoma has been identified among these operators.

CASE STUDY -- IMPROVED CONVERSION OF VINYL CHLORIDE MONOMER
IN PVC SUSPENSION AND PVC DISPERSION OPERATIONS

The economic realities of the VCM resin business since 1965 have forced all resin producers to seek improved efficiencies in conversion of VCM to PVC through modification of operating procedures and plant facilities.

Increases in monomer efficiency (Polymer/Monomer Charged x 100) from 85 per cent in 1968 to 96 per cent in 1974 in suspension resin manufacture are documented, with improved machinery for recovering VCM from vapors released in venting and stripping sections estimated to have accounted for more than half of the improvement. Similar improvements in monomer efficiency within the PVC dispersion resin process have been recorded; 78% in 1968 increasing to 91 per cent in 1973 is representative of the improvement. While such increases in monomer efficiency were oriented toward economic considerations, reductions in monomer lost to the air lessened the amount that emitted to the workplace atmosphere. Graphs A and B record the annual improvements being achieved in monomer efficiency in polymer production of both suspension and dispersion resins.

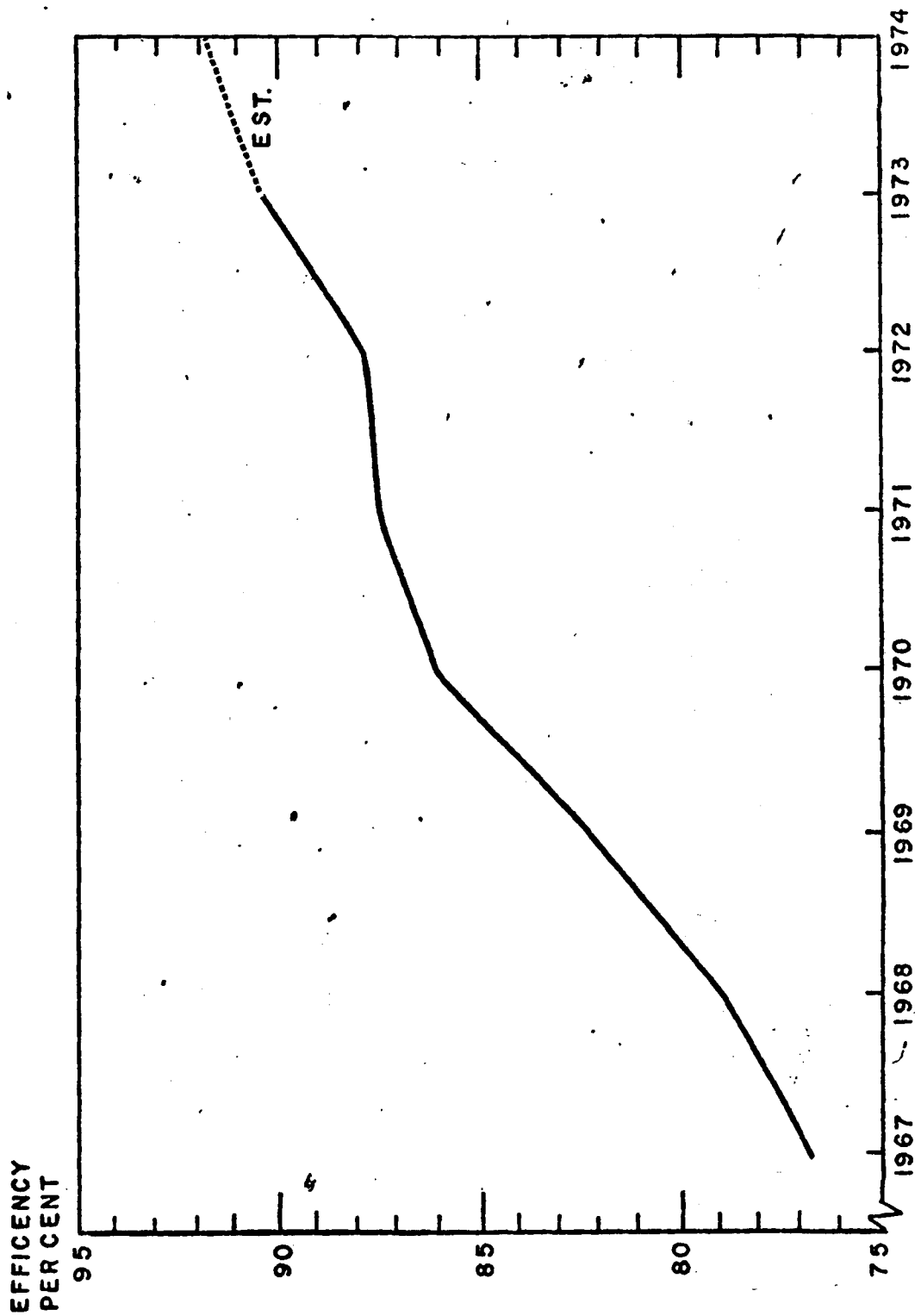
Recent measurements within both PVC suspension and dispersion operations established that maximum VCM levels in the workplace air approximated 30 ppm TWA (eight hour) at a ceiling of 45 ppm. Based on the known improvement in monomer efficiency, it is certain that the VCM levels in the workplace environment in 1974 are below those of prior years when recovery was less efficient; that PVC workers in the prior years were exposed to significantly higher concentrations than is presently experienced.

The employee health records of workmen operating in the vast majority of the plants where the data show a significant and continuing reduction in VCM losses from the experience of 1967 show no measurable deterioration in the health of the workmen exposed during this period.

POLYVINYL CHLORIDE DISPERSION RESIN OPERATIONS

VINYL CHLORIDE EFFICIENCY

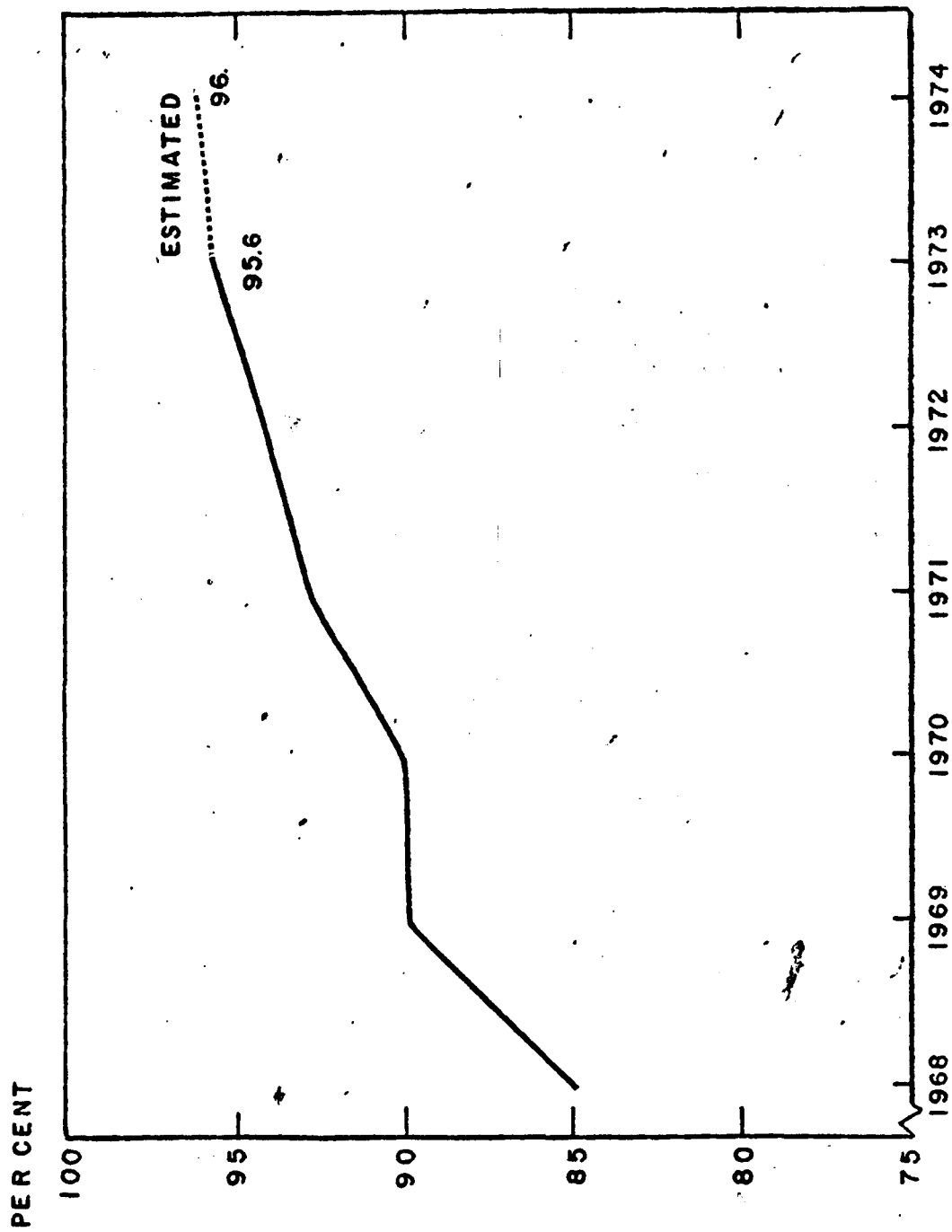
TOTAL POLYMER/MONOMER CHARGED X 100



POLYVINYL CHLORIDE SUSPENSION RESIN OPERATIONS

VINYL CHLORIDE EFFICIENCY

TOTAL POLYMER/MONOMER CHARGED X 100



CASE STUDY - PVC SUSPENSION PLANT - DOW CHEMICAL COMPANY

Testimony of V. K. Rowe
at Public Hearing on VCM (OSHA)
February 15, 1974

"Our Polymer Plant #1 was operated from 1946 to 1972. Between 1950 and 1959, several industrial hygiene surveys were conducted. A number of job classifications (polymerizer operators, drier operators, monomer still operators, and monomer transfer operators) had workplace environmental levels ranging from 50 to 385 ppm vinyl chloride. After installation of a continuous analyzer for the workplace air in 1959, improvements were achieved. Vinyl chloride TWA values ranged from 25 to 85 ppm during the period 1960 - 1967."

"Our present Polymerization Plant, Polymer Plant Number Two, began operation in 1953. Historically the TWA values have been decreased over this period of time. In the early history, TWA values of 105 - 240 ppm were observed. During 1973, TWA values for vinyl chloride in the air were in the 1 to 25 ppm range."

INDUSTRY PROFILE

PVC resin production in the United States approximated 4,600,000,000 pounds in 1973:

Number of producers (domestic)	22
Number of Plant locations	36
Number of producers by process:	
Suspension	- 22
Dispersion	- 10
Bulk Non-solvent	- 4
Solvent	- 1
Emulsion	- 3

Number of Production Workers: 5,045

Relative to the number of domestic plants manufacturing PVC resins, only four plants have been identified as having a possible connection between vinyl chloride exposure and the development of angiosarcoma in workmen; ten of the twelve cases being traced to two plant locations.

PVC PLANT LOCATIONS
U.S. PRODUCERS - 1974

<u>PVC Plant No.</u>	<u>Plant Startup Date</u>	<u>No. of PVC Workers</u>	<u>Reported Cases Angiosarcoma</u>
1	1957	64	0
2	1963	46	0
3	1961	80	0
4	1963	155	0
5	1946	75	0
6	1966	158	0
7	1968	120	0
8	1954	130	0
9	1953	300	0
10	1960	40	0
11	1970	55	0
12	1946	300	3
13	1956	60	0
14	1956	27	0
15	1956	76	0
16	1966	140	0
17	1963	187	0
18	1936	272	1
19	1947	140	0
20	1959	74	0
21	1955	150	0
22	1950	74	0
23	1971	30	0
24	1953	241	0
25	1965	200	0
26	1947	350	1
27	1965	70	0
28	1965	180	0
29	1942	266	7
30	1969	90	0
31	1955	98	0
32	1968	150	0
33	1965	95	0
34	1967	160	0
35	1957	70	0
36	1949	322	0

UNITED STATES PVC PLANTS
DURATION OF RESIN MANUFACTURE

<u>Span of Operations</u>	<u>Number of Plants</u>
1 to 5 Years	3
6 to 10 Years	9
11 to 15 Years	6
16 to 20 Years	8
21 to 25 Years	4
More than 26 Years	6

GENERAL CONSIDERATIONS

Various parties involved in considering the possibility that vinyl chloride monomer is a causative agent of angiosarcoma in humans recognize:

- that as of this date no definite connection has been established between angiosarcoma among workers and any of the major chemical raw materials used in polymerization of PVC. However, vinyl chloride monomer, being a volatile chlorinated hydrocarbon, is the primary target due to its being the abundant raw material to which workers might have had the most exposure.
- that vinyl chloride is not the only raw material involved in resin production in the two plants where multiple cases of angiosarcoma have been identified among workers; acrylates, vinylidene chloride among others have been listed as additional reactants.
- that no rationalization has yet been published as to why the lack of angiosarcoma among workers in the vast majority of PVC plants employing the same basic processes for resin manufacture; none among workers in other plants of the same producers reporting multiple cases of angiosarcoma in single plant locations.
- that the development of angiosarcomas of the liver developed in animals exposed to vinyl chloride has been used to postulate that VCM is the etiologic agent in the excess of deaths due to angiosarcoma of the liver in PVC workers. A trace of the possible impact of exposure in other work situations, of the eating and drinking habits of the afflicted workers, and of other complicating health problems has not been made.

The National Institute for Occupational Safety and Health (NIOSH) has branded VCM as a potential health hazard to PVC workers primarily on deduction. Yet the health experience of workers in the 36 PVC polymerization plants indicates that no serious health problems exists generally in PVC plants with but two exceptions.

A. B. Steele

May 15, 1974

The Processors Subcommittee met on May 15 at the SPI Headquarters. Present were Hal Allick of Goodyear, Art Smith of Robintech, Tom McGrath of SPI and I.

We reviewed the data that was sent to us by a number of processors with the intention of establishing some recommendations for a position regarding the applicability of the proposed permanent OSHA standard as it relates to the PVC processors.

While the data submitted was very helpful, the subcommittee could not draft a position for the processors because of the limiting nature of the data. However, the data did suggest several areas where we should conduct some testing which will lead to the development of a position paper.

The Processors Subcommittee has drawn the following observations from its May 15 meeting:

- 1) We strongly recommend that monitoring and analysis for free VCM be done in various processing plants by either a recognized laboratory or a team of volunteers from the companies who are represented on the full committee;
- 2) It appears that processors who buy pelletized PVC compounds should not encounter VCM levels over one part per million.
- 3) Dry blend compounds produced by intensive mixing have VCM levels such that processors should have no free VCM in operator breathing zones over 1 ppm.
- 4) There is the potential for high VCM concentrations at the hatches of rail cars and trucks containing bulk PVC resin, and therefore, the opening of the hatches would require employee protection. The air space within the silos, and other storage units, also have the potential for high VCM concentrations, and such operations as silo sampling and inspection require employee protection.
- 5) It appears that bag resin dissipates VCM, and warehouse operations must be surveyed to determine VCM levels, if any.
- 6) Blending operations complying with OSHA clean air requirements present no problems in operator breathing zones. We have assumed that compliance with OSHA clean air standards probably require individually vented blenders.
- 7) The limited data on plastisol operations indicated levels below one ppm. Additional data should be gathered in coating and molding operations.

The subcommittee is of the opinion with the exception of storage that if PVC processors meet current clean air standards then there should be no measurable VCM in their plants.

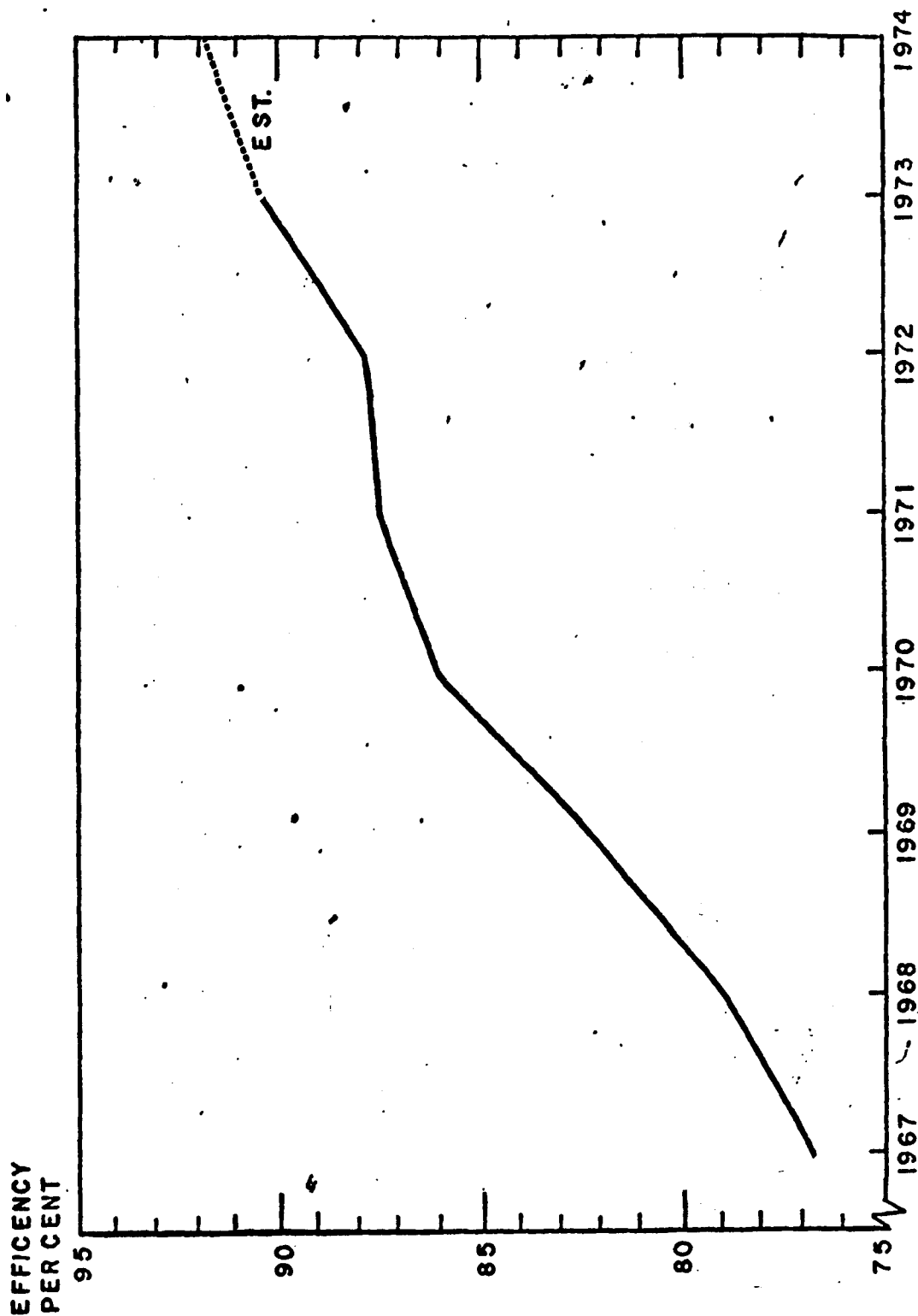
Respectfully submitted,

Jack Jaglom,
Chairman

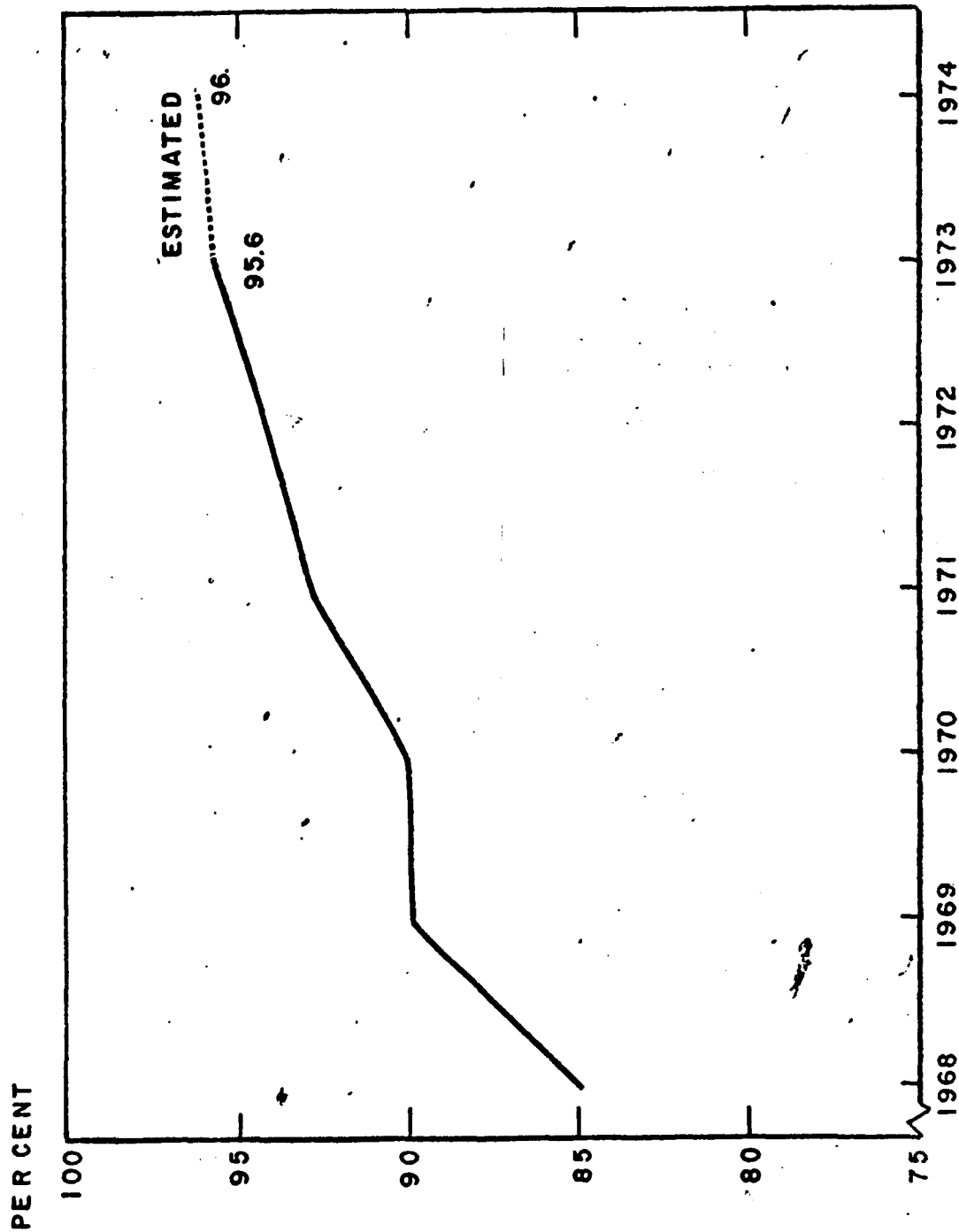
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SPI- 09575

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Chairman

SPI- 09576

