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A STATISTICAL EVALUATION OF RESPIRATORY SYSTEM
INDICATORS AMONG PIPE COVERERS

INTRODUCTION

This report presents statistical findings developed from an epidemiologic study of pipe coverers. The report does not include a review of literature on the subject or a medical interpretation of the results. In the location under study, the job of pipe coverer has existed since 1910. A list of 173 men who have held this job was prepared from company personnel records. Virtually all men who worked on the job for at least a year are included in the list, as well as most of the men who worked less than a year. As of January 1970, the status of the 173 men was as follows:

Still Working For Company	130
Active Pipe Coverers	94
No Longer Pipe Coverers	36
Quit or Released From Company	18
Retired	12 11
Deceased	13 14

Within the identified exposed-to-risk population, the relationship between time-on-job and health indicators reflective of the well-being of respiratory function was investigated. The health indices examined in this study include (1) the mortality rate for cancer of the respiratory system (based on company insurance records, 1940-1970); (2) the incidence of morbidity episodes involving diseases of the respiratory system (based on company insurance records, September 1969-August 1970); and, (3) vitalometer measurements (derived from a multiphasic health screening program, 1967-1970).

METHODOLOGY

Selection Of Exposed-To-Risk Population And Controls

Pipe coverers were identified through personnel lists prepared on a monthly basis by the company. The personnel lists are ordered by department and job classification within department and are retained as far back as the 1920's. However, only the January listings are retained beyond ten years. Since pipe coverers tend to remain on the job for a long period of time, this method is adequate for identifying the exposed-to-risk population.

Two sets of controls were utilized in this study. The first set of controls consisted of the total plant population and the second consisted of pipe fitters. While the total

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plant population was selected for convenience, a probability sample of the pipe fitter population was selected because these men had jobs closely related to the pipe coverers except for exposure to asbestos. The pipe fitters were identified by the same method as was used to identify the pipe coverers. Because there are many more pipe fitters than coverers, a thirty percent sample was drawn by terminal digit sampling of company identification numbers.

Method of Morbidity Analysis

For the purpose of this study, a morbidity episode is an absence characterized by the filing of a proper accident and sickness benefits claim covering a continuous period of absence from work. The claim includes a physician's certification of the medical cause of the absence. In most cases, the morbidity episode must extend beyond seven calendar days before a record of the event is created. The program, as such, is available to hourly employees of the company. The expected number of disability days shown in Tables 1 and 2 are based on a five year age grouping of data on over 5,000 hourly employees.

Method of Vitalometer Analysis

The company's multiphasic screening program, offered on a voluntary basis, calls for F.E.V. Total and F.E.V. 1 Sec measurements to be recorded for each participant. A Collins Vitalometer produces the tracings which are digitized by a technician. For analysis purposes, the most positive of three repeated tracings for each individual is computerized. A regression equation was developed from the total screened population to adjust for height and age. Monthly comparison of measured results has shown that, over the three years of the program, consistent readings have been obtained.

Using data generated through a multiphasic screening program has the advantage that neither the subject nor the technician is aware of uses to which the results might be put. Participation in the health inventory program was about 67% during the first cycle of the program. By combining first and second cycles, vitalometer readings were obtained for 101 men in the pipe coverer population.

Several selection factors which could bias somewhat the findings of this study should be noted. First, it was not feasible to follow up on the 18 employees who left the company; two of these men were known to have left because of poor health.

Secondly, a morbidity study covering a period two years following the first cycle of the multiphasic screening program revealed that participants in the program experience fewer illness-absence episodes than non-participants. The study did not enable us to determine the reasons for this difference.

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While the same selection factors apply to the control populations, caution must be exercised in interpreting results because of these unknowns.

Method of Mortality Analysis

The mortality analysis is based on copies of death certificates received by the company Group Insurance Department as proof of death. As mentioned previously, individuals released from the company, excluding retirees, will be lost to a mortality study based on insurance records. The two control groups referred to in Table 6 were studied over a more recent time period than the pipe coverers, even though the first twenty years following initial placement on the job was not accumulated as part of the exposure-to-risk years for pipe coverers. However, since the mortality rate due to cancer of the respiratory system has been increasing over the years, this comparison should error slightly on the conservative side. The mortality rates for the three groups were calculated on an age-adjusted basis.

Smoking History

A smoking history collected as part of the multiphasic screening program was not judged as satisfactory for use in this study. The set of questions concerning smoking history has been restructured and appears to be producing results that can be useful in the future. The lack of smoking history does impose considerable limitations on the conclusions that can be drawn from the study.

RESULTS

Table 1 shows that while no pipe fitter employment groups differ from the total plant in disability days due to respiratory disease, there are differences among the pipe coverers. The largest difference occurs among pipe coverers with 10 years or more of continuous employment on the job. These differences, however, are not fully reflected in total disability days. In Table 2, the number of episodes involving respiratory disease are compared. Based on a poisson approximation test, significant differences between observed and expected episodes were found for three employment groups among the pipe coverers and for no pipe fitter groups. However, the significant differences in the continuously employed group might be expected to carry over to the total group.

Vitalometer Analysis

The readings shown in Table 3 are height and age corrected. Only after ten years of employment do significant differences between corresponding groups of pipe coverers and fitters appear. The prior-to-employment group consists of men who worked at other jobs during the first cycle of the multiphasic screening program and later became coverers or fitters. A non-linear regression equation

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was developed for F.E.V. Total and F.E.V. 1 Sec using years since first exposure as a pipe coverer for the independent variable. The regression lines, along with the scatter plot of individual readings, are shown in Figure I through Figure IV for both fitters and coverers.

Mortality Analysis

All causes of death among pipe coverers up to 1970 are listed in Table 5. These deaths are categorized by interval between initial employment as a pipe coverer and death, and by length of employment as a pipe coverer. An excess of total deaths and respiratory cancer deaths among pipe coverers, as compared to two other groups, is indicated in Table 6. The number of observations is quite small. In addition, two of the men dying from respiratory cancer also worked with lead arsenate.

SUMMARY

The data presented in this study were derived only from ongoing routine functions of the company Medical Department. The investigation of vitalometer readings, morbidity episodes due to respiratory disease, and mortality due to respiratory cancer, indicated that pipe coverers performed less well than did the comparison groups.

There are two important limitations of the study aside from the size of the exposed-to-risk population. First, no smoking history was obtained. Second, follow-back of individuals no longer with the company was not undertaken.

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Table 1. DISABILITY DAYS⁽¹⁾ PER PERSON PER YEAR AMONG PIPE FITTERS AND PIPE COVERERS ACCORDING TO LENGTH OF EMPLOYMENT (AGE CORRECTED).

Pipe Fitters					
Employment as a Pipe Fitter	Number of Men ⁽²⁾	Total Disability Days		Disability Days Due To Respiratory Disease	
		Observed	Expected ⁽³⁾	Observed	Expected
Continuous <10 Years	56.3	5.8	8.4	0.8	1.4
10 Years or more	34.5	9.3	12.6	1.7	1.9
Both Continuous and Non-Continuous ⁽⁴⁾					
<10 Years	58.3	6.7	8.5	0.8	1.6
10 Years or more	67.5	12.1	12.2	1.4	1.9

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Pipe Coverers					
Employment as a Pipe Coverer	Number of Men	Total Disability Days		Disability Days Due To Respiratory Disease	
		Observed	Expected	Observed	Expected
Continuous <10 Years	57.0	8.0	8.8	2.1	1.5
10 Years or more	33.7	13.8	13.0	7.4	1.9
Both Continuous and Non-Continuous					
<10 Years	70.1	12.6	8.5	4.7	1.4
10 Years or more	57.0	11.9	12.7	5.0	1.9

(1) Disability days include non-working days. The analysis period is from September 1969 to September 1970.

(2) Number of men take on fractional values because some men may have retired or quit the company within the study period.

(3) Expected values are calculated from the total plant experience and are age-corrected.

(4) This category includes men who may have worked for several years as a fitter or coverer and then changed jobs within the company.

**Table 2. DISABILITY EPISODES DUE TO RESPIRATORY DISEASE
AMONG PIPE FITTERS AND PIPE COVERERS.**

Employment	Number of Episodes			
	Pipe Coverer		Pipe Fitter	
	Observed	Expected	Observed	Expected
Continuous				
< 10 Years	9	5.4	5	5.1
10 Years or more	14**	3.7	2	3.7
Both Continuous and Non-Continuous				
< 10 Years	16**	6.4	5	5.3
10 Years or more	14**	6.2	5	7.3

**Significant at .01 level.

There were no statistical differences between expected and
observed episodes among pipe fitters.

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Table 3. VITALOMETER READINGS FOR PIPE COVERERS AND
PIPE FITTERS BY EMPLOYMENT CATEGORY BASED ON
HEALTH INVENTORIES.

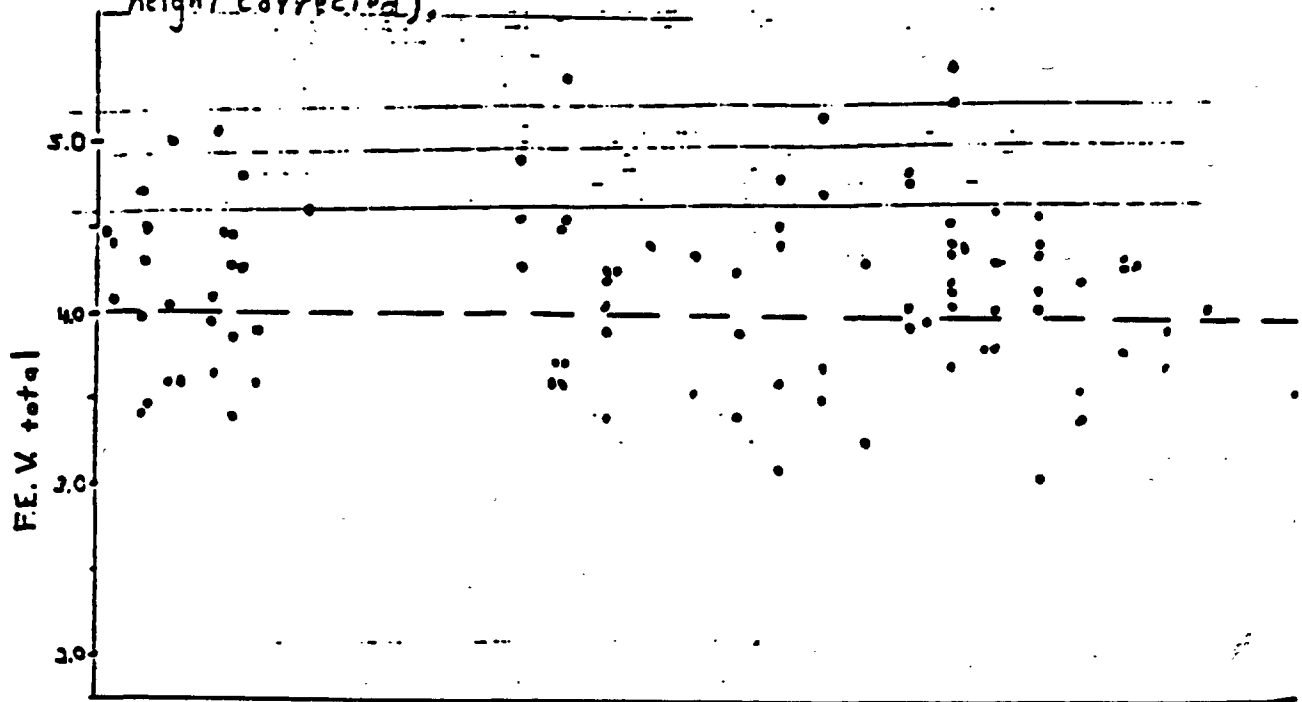
Employment Category	Pipe Coverers			Pipe Fitters		
	Nbr.	F.E.V. Total	F.E.V. 1 Sec.	Nbr.	F.E.V. Total	F.E.V. 1 Sec.
Total	101	3.87	3.31	111	4.13	3.60
Prior to Employment	20	3.90	3.38	14	4.03	3.67
Continuous Employment						
<10 Years	21	4.17	3.58	24	4.14	3.62
10 Years or more	30	3.76**	3.28	34	4.12	3.51
Total Employment ⁽¹⁾						
<10 Years	27	4.10	3.61	27	4.14	3.63
10 Years or more	54	3.75**	3.23**	70	4.15	3.57

(1) Years are calculated from date of first exposure regardless of the duration of employment.

**Mean value for Pipe Coverers significantly different than mean value for Pipe Fitters at the .01 level (Student's -t Test)

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Figure I. Scatter Plot of F.E.V. total readings for 97 pipe fitters by years since first employment as a fitter (age and height corrected).



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Figure II. Scatter Plot of F.E.V. total readings for 81 pipe coverers by years since first employment as a coverer (age and height corrected).

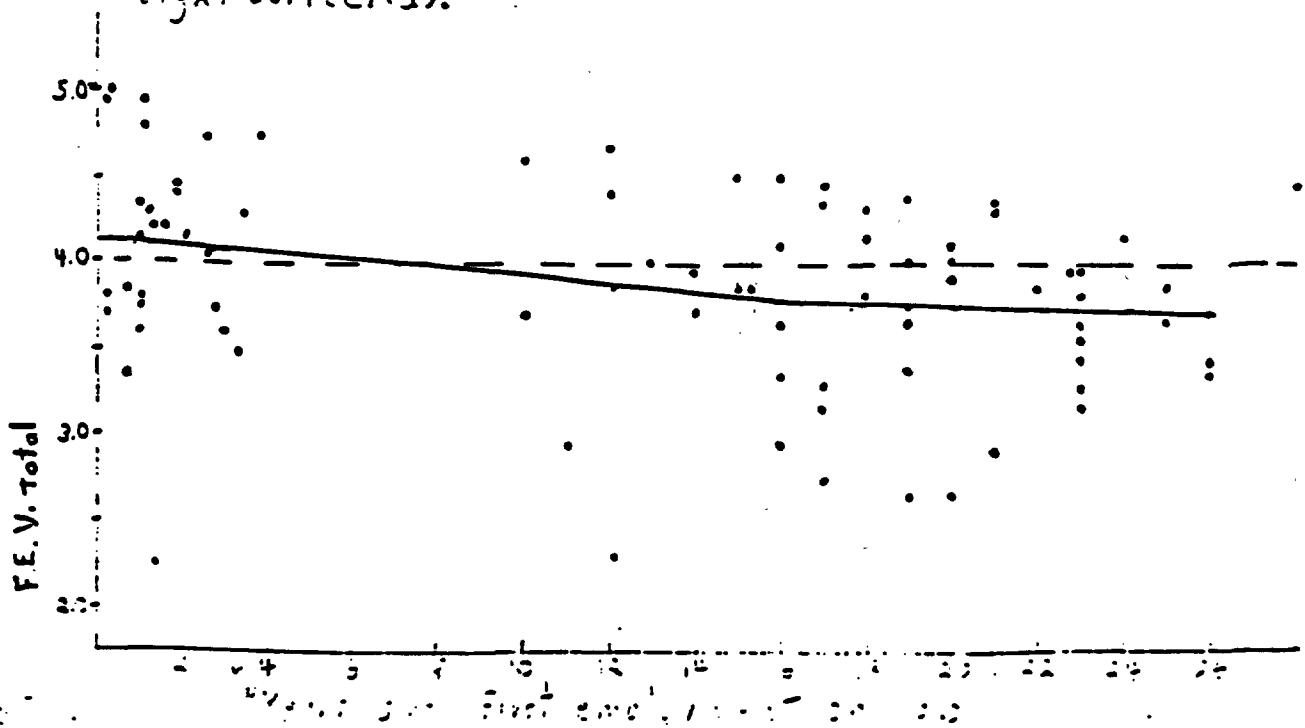


Figure III. Scatter Plot of F.E.V. 1 sec readings for 97 pipe
 fitters by years since first employment as a fitter (age
 and height corrected).

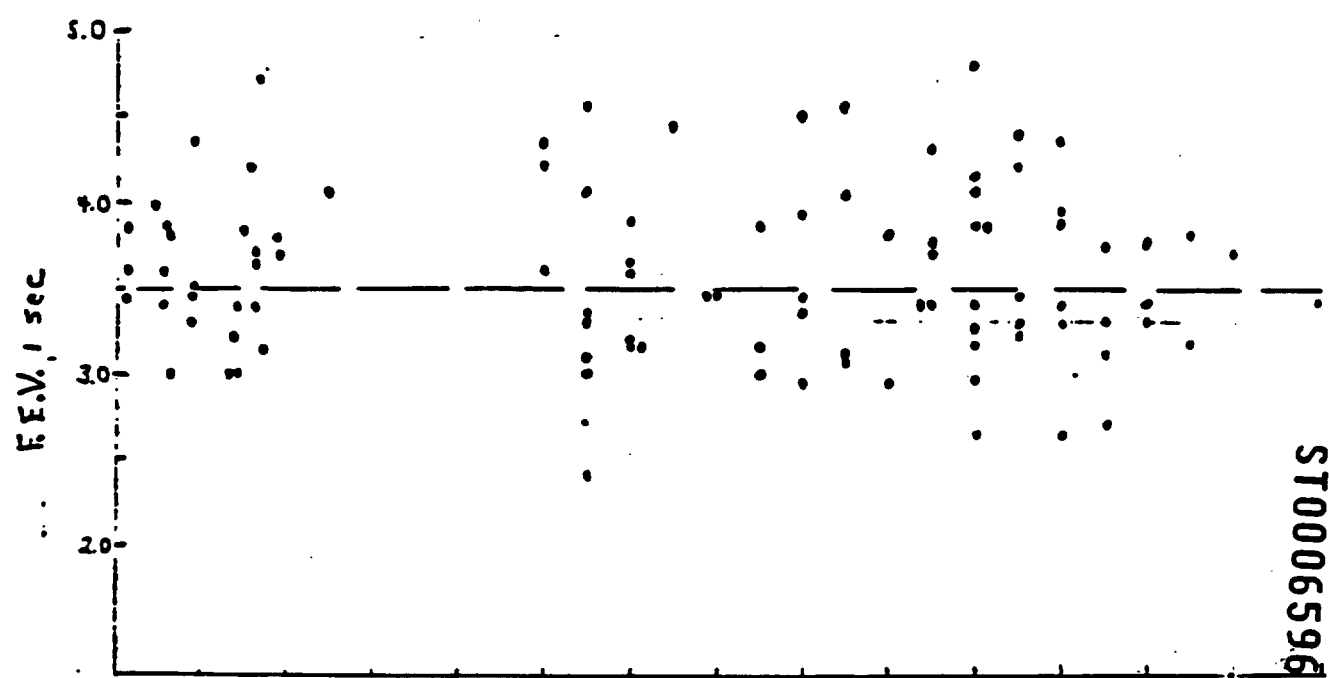


Figure IV. Scatter Plot of F.E.V. 1 sec readings for 81 pipe coverers
 by years since first employment as a coverer (age
 and height corrected).

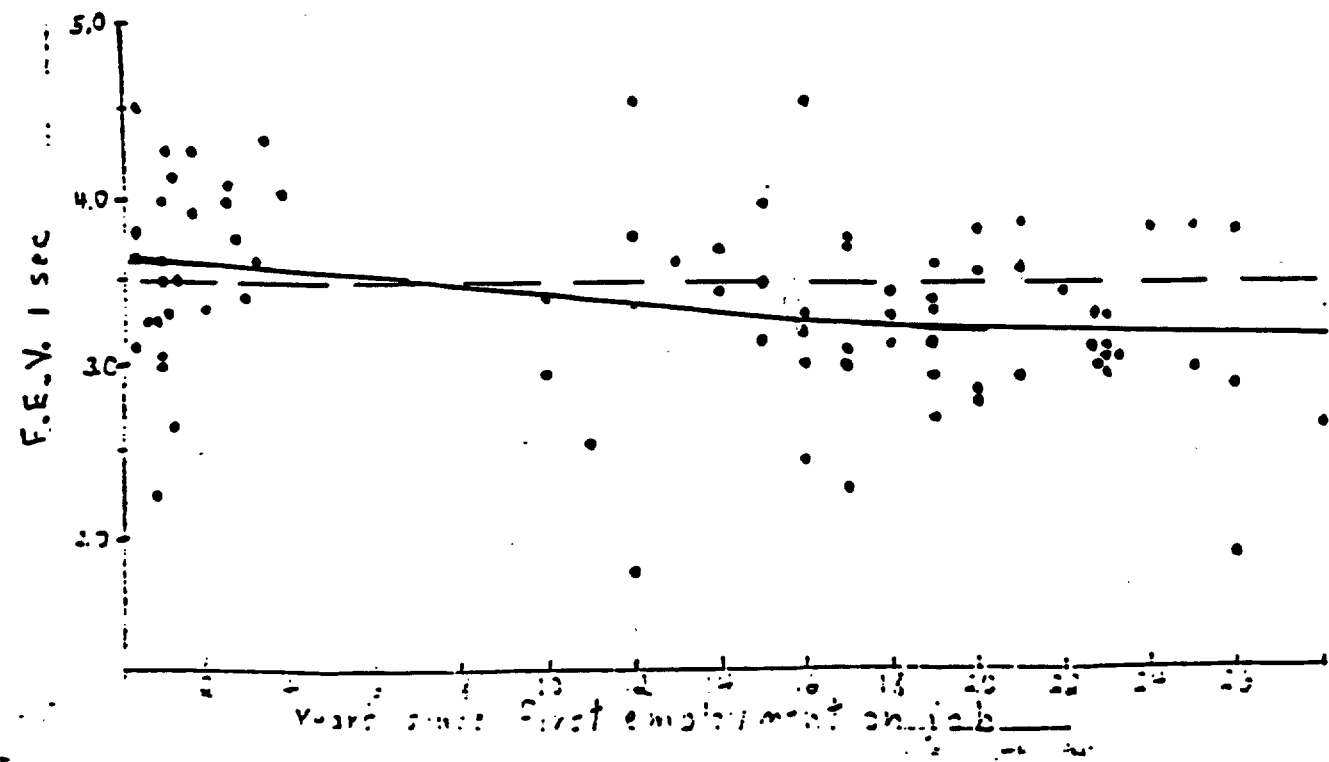


Table 5. CAUSES OF DEATH BY YEARS WORKED AS PIPE COVERER AND BY INTERVAL BETWEEN INITIAL EMPLOYMENT AS A PIPE COVERED AND DEATH. (BASED ON DEATHS REPORTED THROUGH SEPTEMBER 1972)

Interval Between Initial Employment As Pipe Coverer And Death							
0 - 9 Years		10 - 19 Years		20 - 29 Years		30 - 39 Years	
Yrs.	Cause of Death	Yrs.	Cause of Death	Yrs.	Cause of Death	Yrs.	Cause of Death
2	Ca. Resp.*	14	Myocardial Infarction	29	Ca. Resp. --	31	Ca. Resp. --
			Infarction --	27	Ca. Resp. --	30	Ca. Esophagus
		6	Suicide --		Post Op. --	21	Arteriosclerotic
				24	Ca. Resp. --		Renal Disease
				22	Fall At Work	7	Ca. Resp.**
				16	Aortic & Mitral Valve Disease		
				12	Ca. Pancreas		
				6	Coronary Occlusion		
				1	Ca. Resp. --		
				<1	Myocardial Infarction		
					(Fibrous adhesions of apex of left lung)		

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*Had previously spent 1-1/2 years in Pb Arsenate 19 years prior to death.

**Had previously spent 3 months in Pb Arsenate 29 years prior to death.

***Had previously spent 1 year in Pb Arsenate 27 years prior to death

1 Mesothelioma not included in above population--Died 1970--Worked grinding asbestos pipe cover to make "cement" for about 1 year (1945?).

Table 6. OBSERVED DEATHS FOR PIPE COVERERS BEGINNING AT 20 YEARS AFTER INITIAL EMPLOYMENT VS. EXPECTED DEATHS BASED ON TOTAL PLANT POPULATION AND U.S. POPULATION MORTALITY RATES (ADJUSTED FOR AGE DIFFERENCES).

	Pipe Coverers* 1930 - 1969	Total Plant 1954 - 1969	U.S. Population 1966
Total Deaths	13	5.9	7.6
Ca. Resp.	6	.6	.5
Other Ca.	2	.9	1.0

*Over 91 percent of the exposed-to-risk years occurred after 1953.

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PIPE COVERER DEATHS

<u>Man Nbr.</u>	<u>Name</u>	<u>Died</u>	<u>Cause</u>	<u>Months Exp.</u>
10333	Crawford	3/72	Accident	233
23533	Burow	6/70	Suicide	77
01373	Brooker	8/45	Ca. Esophagus	369
01433	Burow	7/53	Ca. Lung	376
01629	Cron	11/55	Ca. Lung	18
02063	Graham	11/66	ASHD	134
02499	Kablback	3/49	Ca. Lung	29
02859	Maynard	10/70	Ca. Pancreas	151
03051	McIntosh	3/69	Ca. Lung	85
03226	Paschick	10/58	Ca. Lung	350
04292	Woods	2/44	M.I.	75
04745	Salva	7/72	Ca. Lung	328
05753	Berridge	/59	M.I.	164
06777	Moline	12/67	M.I.	6
18849	Peek, A.L.	1/71	Ca. Lung	293
19626	Krawcz	12/64	Heart	196
01724	Dewey, A.C.	3/69	M.I.	3

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