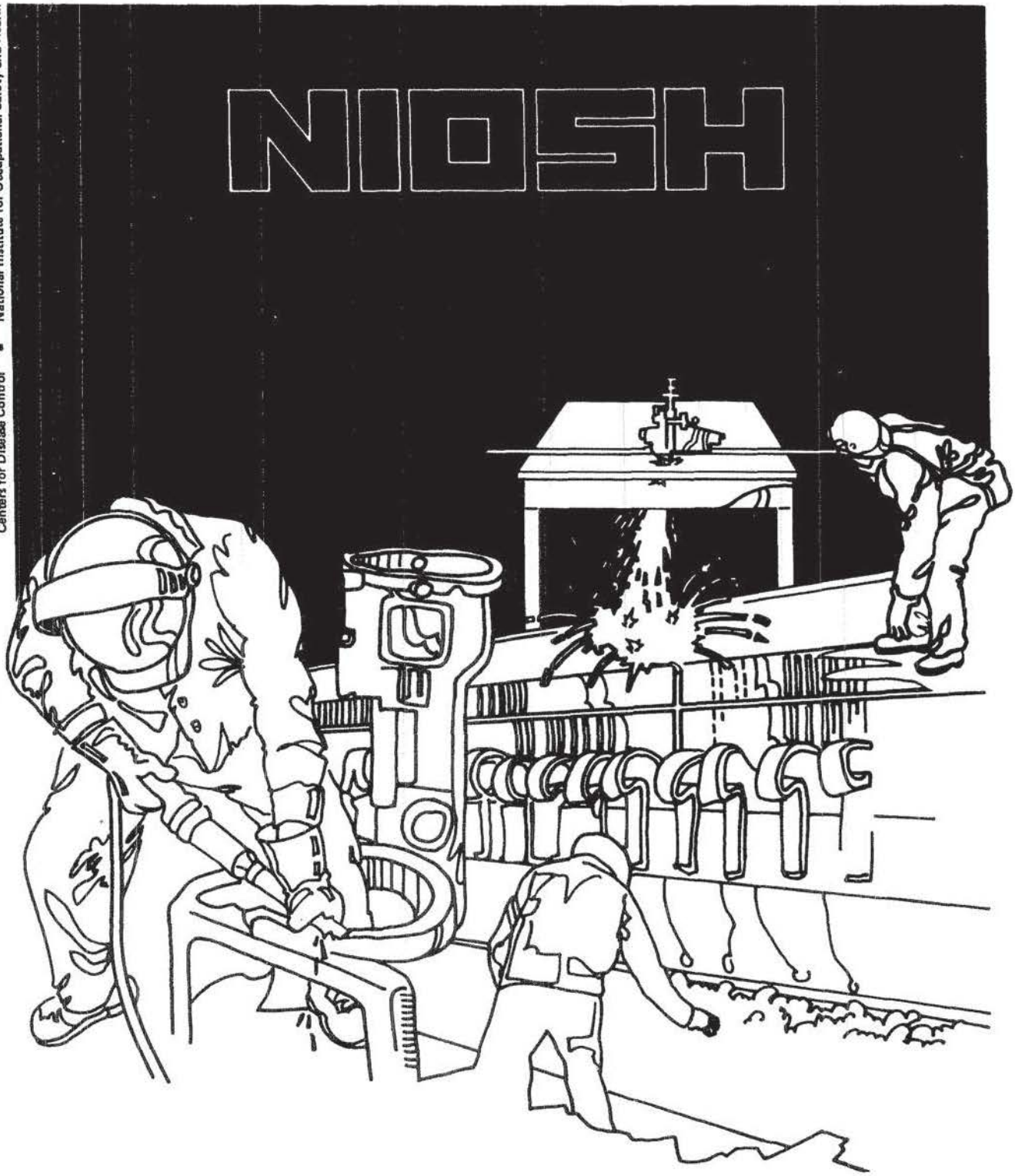
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 81-449-1094
LOUISIANA-PACIFIC
MELLEN, WISCONSIN

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-449-1094
April 1982
Louisiana-Pacific
Mellen, Wisconsin

NIOSH Investigators
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I. SUMMARY

In September 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Woodworkers of America Local 4-335 to evaluate health hazards associated with veneer dryer emissions at Louisiana-Pacific in Mellen, Wisconsin.

On September 24-26, 1981, environmental air samples for alpha and beta pinene, abietic acid, pimaric acid and tannic acid were collected to determine the workers' exposures to veneer dryer emissions. Area samples were collected near the workers in the feeder, offbearing and grader areas. These areas are 15 feet or more from the source of the emissions and were considered representative of the workers' exposures. A short pre and post-shift medical questionnaire was administered to the employees. The questionnaire sought information on the following symptoms: dry or irritated eyes; dry, running or irritated nose; and dry, sore or irritated throat.

When oak was being dried in both dryers the mean concentration of pinene in air was 0.10 mg/cu m. The abietic and pimaric acid concentrations were 0.014 mg/cu m. and the mean tannic acid concentration was 0.013 mg/cu m. Tannic acid is found in oak but not in pine. During the period that pine was dried in one dryer and oak in the other, the mean pinene concentration went up to 1.47 mg/ cu m. The abietic and pimaric acid concentration went up by a factor of 7 to 0.034 mg/cu m.

During the shifts on which only oak was being dried, 26 of 68 workers had one or more symptoms. These symptoms were not present at the start of the shift. When both oak and pine were dried 8 (53%) of 15 had one or more symptoms. This is less than the swing shift (13 of 22 or 50%) when only oak was dried. Although many stated pine was worse than oak there was no significant difference in the adverse health effects reported. Although accurate numbers were not kept, many employees stated they had sinus problems.

Twenty-eight of the 40 symptoms reported when oak was being dried involved dryness of the eyes, nose and throat. This is a high percentage considering the outside weather was overcast and drizzly. This effect is probably caused by the oak. Oak is a short fibered wood. There was a considerable amount of fine settled dust on equipment in the drying area. The fine, dry oak dust in contact with mucous membranes will tend to be hydroscopic and draw moisture from the point of contact, causing dryness. In addition oak contains tannic acid which also causes local drying of the skin and mucous membranes.

On the basis of this and six previous veneer dryer studies, NIOSH determined that: the drying of pine may cause short term irritation of the eyes, nose and throat but probably does not cause any long term problems, especially since pine is dried only one or two shifts a month; and the drying of oak may produce dryness of the eyes, nose and throat and may be the cause of the chronic sinus problems.

Recommendations to eliminate leaks in the dryer and for medical monitoring and education are included in this report.

KEYWORDS: SIC 2435 (Hardwood Veneer and Plywood) Plywood Veneer Drying Oven emissions, pinene, abietic and pimaric acid, tannic acid.

III. INTRODUCTION

In September 1981, NIOSH received a request from the International Woodworkers of American Local 4-335 to determine if a potential health hazard existed due to exposure to veneer dryer emissions in the veneer drying process at Louisiana-Pacific in Mellen, Wisconsin. A combined initial and environmental survey was conducted on September 23-26, 1981. An interim report, including the environmental and questionnaire results, was submitted to the company and the requestor.

III. BACKGROUND

A. Plant Process

Louisiana-Pacific manufactures veneer. The veneer is peeled in an area of the plant adjacent to the veneer dryer area. The veneer sheets are hand-fed into two continuous-feed, steam-heated veneer dryers which dry the veneer to a predetermined moisture content. As the dried veneer sheets exit from the dryer, they are removed by hand and graded. The veneer sheets are subsequently joined, patched, and assembled into panels. The panels are then shipped to other plants for layup. This Health Hazard Evualuation request involves only the veneer drying areas.

This company has two steam-heated veneer dryers in operation. Veneer dryers are usually equipped to carry the stock through the dryer by a series of rolls. The rolls comprise a line with the dryers usually containing from four to eight lines. The lines are enclosed in a shell of sheet metal which is divided into sections. The shell also contains fans, ducts, and baffles for circulating and directing heat to the various lines. The temperatures used are usually less than 400°F. The temperatures used in this plant were approximately 275 to 300°F. (Figure 1 is a schematic diagram of a typical dryer.)

As the water is given up by the heated veneer, it is converted to steam and when mixed with air makes an excellent drying medium. The amount of moisture in the dryer is controlled by dampers in the venting stacks which allow excess steam to escape into the atmosphere. The air-steam mixture is kept in constant circulation by the large fans in the dryer.

Since there are large fans circulating the air in the dryers, a portion of the air in the dryer is under negative pressure and a portion is under positive pressure. Air under positive pressure will seek out cracks and openings. Since a dryer has leaks around door seals, and also is open on both the feeding and offbearing ends of the dryer, the air escapes from the dryer into the surrounding room atmosphere. The air that escapes from the dryer will contain steam plus the hydrocarbons that were volatilized from the wood. The hydrocarbons include alcohols, ketones, esters, aldehydes, terpenes, fatty acids and resin acids. The hydrocarbons can be divided into two categories--those which condense at ambient temperatures and those that remain volatile.

Red oak and pine were the wood species processed during this evaluation. The largest portion of the volatile hydrocarbons emitted during the drying consists of alpha and beta pinene and the majority of the condense hydrocarbons are abietic and pimaric acids. Tannic acis is also emitted from red oak.

IV. EVALUATION DESIGN AND PROGRESS

The environmental survey was conducted on September 24-26, 1981. The environmental evaluation consisted of measuring the employees exposure to the alpha and beta pinenes, abietic and primaric acid and tannic acid in the area of the feeders, offbearers, and graders.

V. EVALUATION METHODS

A. Environmental

1. Total Acids - General area acid samples were collected using four Bendix Electrostatic Precipitator (ESP) units at 12,000 volts DC and at a flow rate of 3.4 cfm. (See Figure 2 for a diagram of the sampling train.) Area samples were collected due to the use of samplers that use 110 volts. The sampling areas, near the feeders, offbearers and graders which were 15 feet or more from the source of the emissions, were considered representative of the workers' exposures. The collected material was analyzed for tannic acid and abietic and pimaric acid.

2. Alpha and beta pinenes - General area samples were collected on charcoal tubes using personal sampling pumps at a flow rate of 1.0 liters per minute. The samples were collected in the exhaust of the ESP units as the acids, if not removed, could interfere with the absorption of the pinenes on the charcoal. (See Figure 2 for a diagram of the sampling train.) The charcoal tubes were analyzed for total pinenes.

B. Medical

The employees in the drying area were questioned concerning past and present health effects they felt could be caused by working in the dryer area. A short pre and post-shift questionnaire was administered to these employees which ascertained symptoms of dry or irritated eyes; dry, runny or irritated nose; and dry, sore or irritated throat.

VI. EVALUATION CRITERIA

A. Environmental Standards

Currently there are no Federal occupational health standards or any recommended levels for occupational exposure to the pinenes,

abietic, pimaric or tannic acids. The range and mean for levels found in previous veneer plant studies are presented below[1,2,3,4,5,12]:

	alpha and beta pinenes mg/cu m		abietic & pimaric acids mg/cu m		tannic acid mg/cu m	
	Range	Mean	Range	Mean	Range	Mean
Plant 1	0.11-5.0	0.73	0.01-0.60	0.21	--	--
Plant 2	0.22-11.0	3.5	0.02-1.2	0.21	--	--
Plant 3	0.40-3.3	1.4	0.004-0.15	0.07	--	--
Plant 4	0.55-14.1	5.0	0.01-2.6	0.79	--	--
Plant 5	0.06-0.45	0.26	0.01-0.20	0.10	--	--
Plant 6	0.50-5.14	1.55	0.02-0.35	0.13	--	--
Plant 7*	0.02-3.10	0.37	0.001-0.057	0.014	0.003-0.040	0.013

*Plant 7 is this evaluation.

B. Toxicity

The information on pinenes and abietic and pimaric acids and tannic acid is scanty but a review of the curent literature plus information on previously studied plywood veneer plants is given below:

1. Pinenes: The pinenes are colorless to yellow liquids with the odor of turpentine. They are the major constituents of oil of turpentine.

   The toxic properties of the pinenes include: a. inhalation - Among the effects observed in humans subjected to severe exposure were irritation of mucous membranes of nose and throat, cough, bronchial inflammation, salivation, headache, vertigo, and irritation of the bladder. It has been reported that continued inhalation of the vapor may cause chronic nephritis and predispose to pneumonia. In 1941 albuminuria and hematuria were reported in men exposed to turpentine vapor with subsequent recovery from such exposures[8], but there is little evidence to suggest that turpentine vapors at low levels are a chronic poison. There is scanty evidence to suggest that some individuals may develop a hypersensitivity to turpentine after prolonged, repeated exposures; b. skin contact - There is little doubt that turpentine is a skin irritant for normal persons if allowed to remain in contact with skin for a sufficient length of time. Some persons are so sensitive that even moderate exposure to vapors will cause a skin reaction. Most people do not develop a dermatitis from occasional contact[6,7,9]; and c. eye contact - A vapor concentration of 200 ppm is moderately irritating to the eyes.

2. Abietic Acid: Abietic acid is a yellow powder with the following physical properties: mol. wt., 302-344, melting point, 137-166°C. There are scanty toxicological data available on this chemical. According to Patty, abietic acid has a low oral toxicity and is not a skin irritant. However, other sources claim that abietic acid is slightly toxic and slightly irritating to the skin and mucous membranes[9].

3. Pimaric Acid: No information is available on this agent either in the standard references or in the current NIOSH Toxic Substance List.

4. Tannic Acid: Tannic acid occurs in the oak species. It is yellowish-white to light brown in color, has a melting point of 200°C and a mol. wt. of 1701. It produces a bluish-black color with ferric salts. Tannic acid causes drying and discoloration of the skin and causes moderate irritation[10,11].

VII. RESULTS

A. Environmental - Twenty area samples were collected over five shifts. During four of the shifts only oak was dried. On the fifth shift pine was dried in the Moore dryer and oak in the Coe dryer. The results are shown in tables 1 and 2. The sample locations are shown on figure 1. The following table lists the summary of the results.

Location	Alpha & Beta Pinene mg/cu m RANGE	Mean	ABIETIC & PIMARIC ACID mg/cu m RANGE	Mean	Tannic Acid mg/cu m RANGE	Mean
feeder area oak	0.02-0.24	0.10	0.003-0.006	0.004	0.003-0.004	0.004
off bearing area oak	0.02-0.33	0.11	0.001-0.042	0.012	0.006-0.040	0.023
all locations oak	0.02-0.33	0.10	0.001-0.042	0.007	0.003-0.040	0.013
feeder area pine & oak	3.10	3.10	0.029-0.057	0.043	--	--
off bearing area pine & oak	0.54-1.26	0.93	0.024-0.024	0.027	--	--
all locations	0.54-3.10	1.47	0.024-0.057	0.034	--	--

The following table compares this study with six previous studies.

	Alpha & Beta Pinene Mean mg/cu m	Abietic & Pimaric Acid Mean mg/cu m	Tannic Acid Mean mg/cu m
past 6 studies	0.26 - 5.0	0.07 - 0.21	None
this study-- drying oak	0.10	0.007	0.013
drying pine and oak	1.47	0.034	None

During the time oak was being dried in both dryers the mean pinene concentration was 0.10 mg/cu m. This is 38% of the lowest mean concentration in previous studies. The abietic and pimaric acid concentrations were 10% of previous studies. The mean tannic acid concentration was 0.013 mg/cu m. Tannic acid is found in oak but not in other species involved in previous studies so no comparison was possible.

During the period that pine was dried in one dryer, the mean pinene concentration went up to 1.47 mg/cu m. This is in the range that was found in the past studies (0.26 to 5.0 mg/cu m, mean 2.07 mg/cu m). The abietic and pimaric acid concentration went up by a factor of 7, however, the mean concentration was still only 1/2 of the lowest mean concentration found in the previous studies.

There was no visible haze in the dryer area when only oak was being dried. Pine was dried from 12:00 midnight to 7:00 p.m. on February 26. By 12:15 a.m. the pine odor was present and by 12:30 a.m. a slight haze started to build up. The haze remained slight throughout the shift.

The outside temperature during the five sampling periods ranged from 50-60°F. The weather varied from overcast to drizzle.

There are four ceiling fans above the dryers; one was shut down for repairs. Inspection of this fan revealed no pitch on the blades, housing, screens or roof area around the fan.

There were several leaks in the Moore dryer. There was a seal blown out on the east side by the top. Several bolts were missing in this section. There were additional leaks on the east side where the duct work joins the side by the doors. One door catch would not lock and one door seal had a bad leak.

B. Medical - The employees in the drying area were questioned concerning past and/or present health effects they felt could be caused by working in the dryer area. The following table is a summary of effects that were experienced post-shift but not pre-shift.

Shift	Wood Species Dried	No. of Persons Affected in Each Category			Total No. of Persons Affected
		Eyes	Nose	Throat	
day	oak	4	7	4	9 of 26
swing	oak	3	10	7	13 of 22
graveyard	oak	0	2	3	4 of 20
graveyard	pine & oak	3	7	7	8 of 15

Note: Several employees had two or three adverse effects.

During the shifts that only oak was being dried, 26 of 68 workers had one or more adverse effects. Since these symptoms were not present at the start of the shift, it indicates that these symptoms clear up between shifts. When both oak and pine were dried 8 of 15 (53%) had one or more advere effects. This is less than the swing shift (13 of 22 or 59%) when only oak was dried. Although many stated pine was worse than oak there was no significant difference in the adverse health effects experienced. Although accurate numbers were not kept, many employees stated they had sinus problems.

Twenty-eight of the 40 symptoms reported when oak was being dried involved dryness of the eys, nose and throat. (The investigators also experienced dryness of eyes, nose, throat and chapped lips.) This is a high percentage considering the outside weather was overcast and drizzly. This effect is probably caused by the oak. Oak is a short fibered wood. There was a considerable amount of fine settled dust on equipment in the drying area. The fine, dry oak dust in contact with mucous membranes will tend to be hydroscopic and draw moisture from the point of contact, causing dryness. In addition oak contains tannic acid which also causes local drying of the skin and mucous membranes. Tannic acid is the sour odor present when drying oak.

VIII. CONCLUSIONS

In the previous studies, during which Douglas Fir was the main species dried, it was found that the short-term effects of irritation of the eyes, nose and throat cleared up overnight and that there was weak evidence of long-term respiratory effects. In this study the concentrations of abietic and pimaric acids and alpha and beta pinenes when drying oak were lower than previous studies and the pinene concentrations were similar to previous studies when pine was dried. Oak was not involved in any of the previous studies. The high incidence of dryness of the eyes, nose, and throat could be caused by the airborne fine oak dust and tannic acid. The constant dryness of the nose could be the cause of many of the complaints of sinus problems. The drying of pine may cause irritation of the eyes, nose and throat but should not produce any long-term problems, especially since pine is dried only 1 or 2 shifts a month.

IX. RECOMMENDATIONS

1. Seal all leaks in the dryer.

2. Replace all missing bolts in the dryer joints.

3. Repair all broken dryer door catches and leaky door seals.

4. Inspect the dryers on a scheduled basis for leaks.

5 Disposable dust respirators should be made available to those workers who desire to wear them to prevent the fine wood dust from entering the mouth and nose.

6. Medical monitoring and education is recommended for all workers assigned to dryer operations:

   a. These workers should be made aware to the irritant effects produced by veneer dryer emissions.

   b Pre-assignment histories and physical examinations should be carried out on all employees, and periodically repeated.

   c. Pre-assignment and subsequent periodic (annual) pulmonary fuction testing (to include FVC, $FEV_{1.0}$, and MMEF 25-75%) should be considered for emplovees in veneer dryer operations to determine if long term emplovees experience an accelerated decrement in pulmonary function.

d. Individuals with a history of asthma or other chronic respiratory condition which is reported or detected by pulmonary fuction testing should be advised that their condition may be made symptomatically worse by working in close proximity to the veneer dryers.

X. REFERENCES

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4. B. Gunter, A. Apol and J. Lybarger, M.D., Health Hazard Evaluation Determination Report 378-21-539; DHEW, CDC, NIOSH - November 1978.

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7. Schwartz, L., L. Tulipau, and S. M. Peck: Occupational Disease of the Skin, 2nd ed., pp. 534-4, Lea and Febiger, Philadelphia, Pa., (1947).

8. Chapman, E.M.: Observations on the Effects of Paint on the Kidneys with Particular Reference to the Tole of Turpentine. J. Ind. Hyg. Toxicology, 23:277 (1941).

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10. The Merck Index, Merck and Co. Inc., Rahway, N.J.

11. Dangerous Properties of Industrial Materials, N. Irving Sax, Reinhold Publishing Corp., New York.

12. A. Apol, T. Wilcox, M.D., J. Lybarger, M.D. Health Hazard Evaluation Report #79-035-972, DHHS, CDC, NIOSH - October 1981.

XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this complete Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its

availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Louisiana-Pacific, Mellen, Wisconsin

2. International Woodworkers of America Local 4-335, Mellen, Wisconsin.

3. Section of Occupational Health, Wisconsin Department of Health, Madison Wisconsin.

4. U.S. Department of Labor, Occupational Safety and Health Agency (OSHA), Region V, Chicago, Illinois.

For the purpose of informing the affected employees, the employer shall promptly post this Determination Report in a prominent place(s) near the work area of the affected employees for a period of thirty (30) calendar days.

XI. ACKNOWLEDGEMENTS

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Originating Office:

Hazard Evaluation and Technical
Assistant Branch
DSHEFS/NIOSH

TABLE 1

ALPHA AND BETA PINENE AND TOTAL ACID AIR CONCENTRATIONS

LOUISIANA-PACIFIC
MELLEN, WISCONSIN

HETA 81-449

LOCATION	DATE	SAMPLE PERIOD	SAMPLE TIME MIN	SAMPLE NUMBER	ACIDS			ALPHA & BETA PINENES	
					SAMPLE VOL. LITERS	ABIETIC & PIMARIC ACID mg/cu m	TANNIC ACID mg/cu m	SAMPLE VOL. LITERS	CONCENTRATION mg/cu
offbearing - Coe dryer	9-24-81	8:35a - 3:17p	402	1	38.7	--	0.006	402	0.12
offbearing - Moore dryer	9-24-81	8:30a - 3:19p	409	2	39.4	0.001	--	409	0.02
feeder end - Coe dryer	9-24-81	8:22a - 3:10p	408	3	39.3	0.003	--	408	0.07
feeder end - Moore dryer	9.24-81	8:26a - 3:14p	408	4	39.3	0.005	--	408	0.07
offbearing - Coe dryer	9-24-81	3:18p - 11:06p	468	5	45.1	0.042	--	468	0.11
offbearing - Moore dryer	9-24-81	3:20p - 11:32p	482	6	46.7	--	0.040	482	0.06
feeder end - Coe dryer	9-24-81	3:13p - 11:11p	478	7	46.0	0.004	--	478	0.06
feeder end - Moore dryer	9-24-81	3:15p - 11:20p	485	8	46.7	0.006	--	485	0.08

NOTE - Red Oak was being dried in both the Coe and Moore dryers during shifts 1 & 2 on 9-24-81

TABLE 2

ALPHA AND BETA PINENE AND TOTAL ACID AIR CONCENTRATIONS

LOUISIANA-PACIFIC
MELLEN, WISCONSIN

HETA 81-449

LOCATION	DATE	SAMPLE PERIOD	SAMPLE TIME MIN	SAMPLE NUMBER	ACIDS			ALPHA & BETA PINENES	
					SAMPLE VOL. LITERS	ABIETIC & PIMARIC ACID mg/cu m	TANNIC ACID mg/cu m	SAMPLE VOL. LITERS	CONCENTRATION mg/cu
offbearing - Coe dryer	9-25-81	11:08p - 6:41a	453	9	43.6	0.005	--	453	0.07
offbearing - Moore dryer	9-25-81	11:25p - 6:45a	440	10	42.4	0.006	--	440	0.05
feeder end - Coe dryer	9-25-81	11:20p - 6:34a	434	11	41.8	--	0.003	434	0.02
feeder end - Moore dryer	9-25-81	11:39p - 6:37a	418	12	40.2	0.004	--	418	0.02
offbearing - Coe dryer	9-25-81	3:30p - 11:05p	455	13	43.8	0.003	--	455	0.33
offbearing - Moore dryer	9-25-81	3:43p - 11:05p	442	14	42.6	0.004	--	442	0.09
feeder end - Coe dryer	9-25-81	3:20p - 11:05p	465	15	44.8	0.003	--	465	0.24
feeder end - Moore dryer	9-25-81	3:35p - 11:05p	450	16	43.3	--	0.004	450	0.24
offbearing - Coe dryer	9-26-81	12:00p - 7:00a	420	17	40.4	0.024	--	420	1.26
offbearing - Moore dryer (West side)	9-26-81	12:00p - 7:00a	420	18	40.4	0.024	--	420	0.54
feeder end - Coe dryer	9-26-81	12:00p - 7:00a	420	19	40.4	0.057	--	420	0.98
feeder end - Moore dryer (East side)	9-26-81	12:00p - 7:00a	420	20	40.4	0.029	--	420	3.10

NOTE - Pine was dried in the Moore dryer and Red Oak in the Coe dryer from 12:00 midnight to 7:00am on 9-26-81
Red Oak was dried in both the Coe and Moore dryers during the other sampling times.

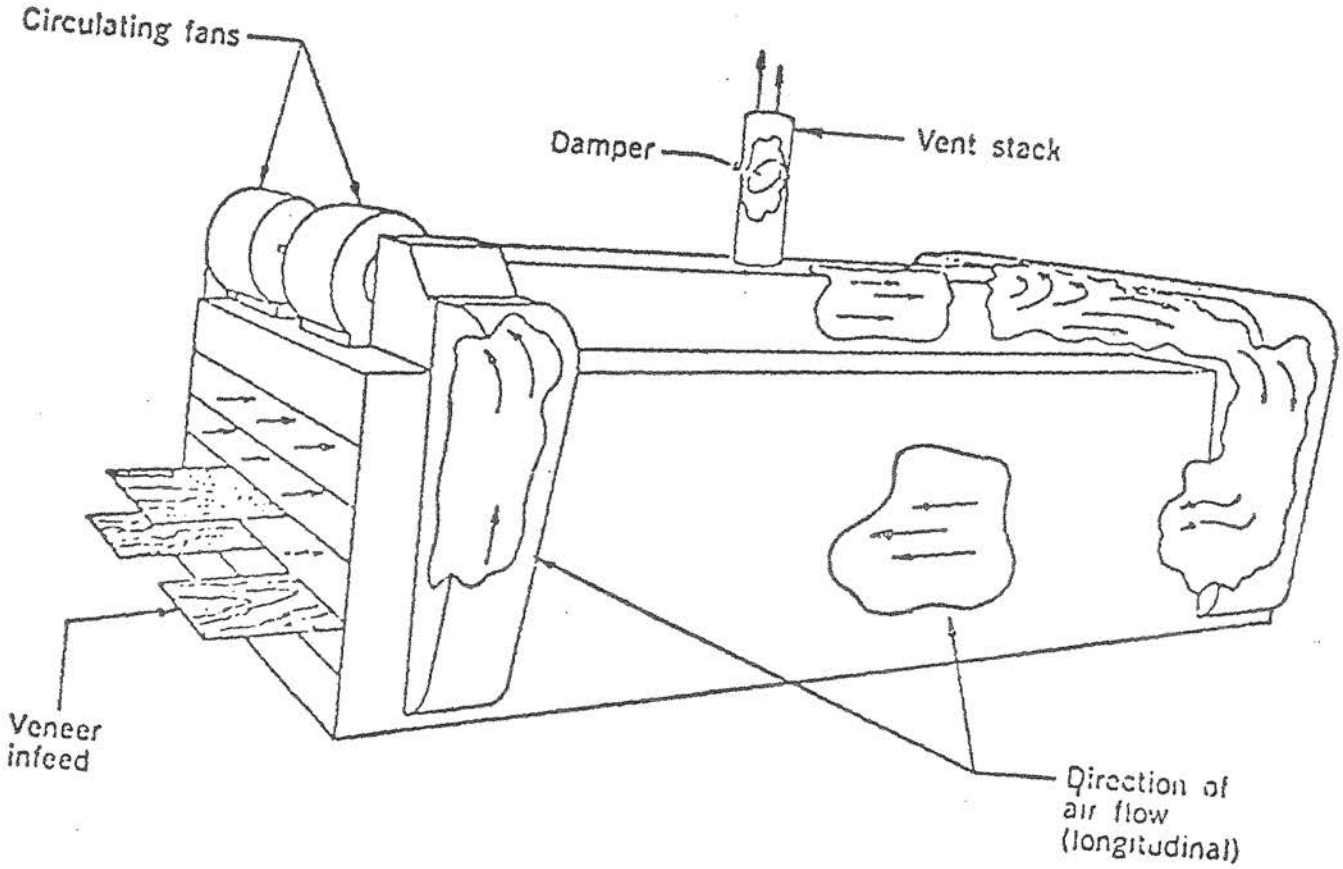


Figure 1 / Veneer Dryer (Single Zone)

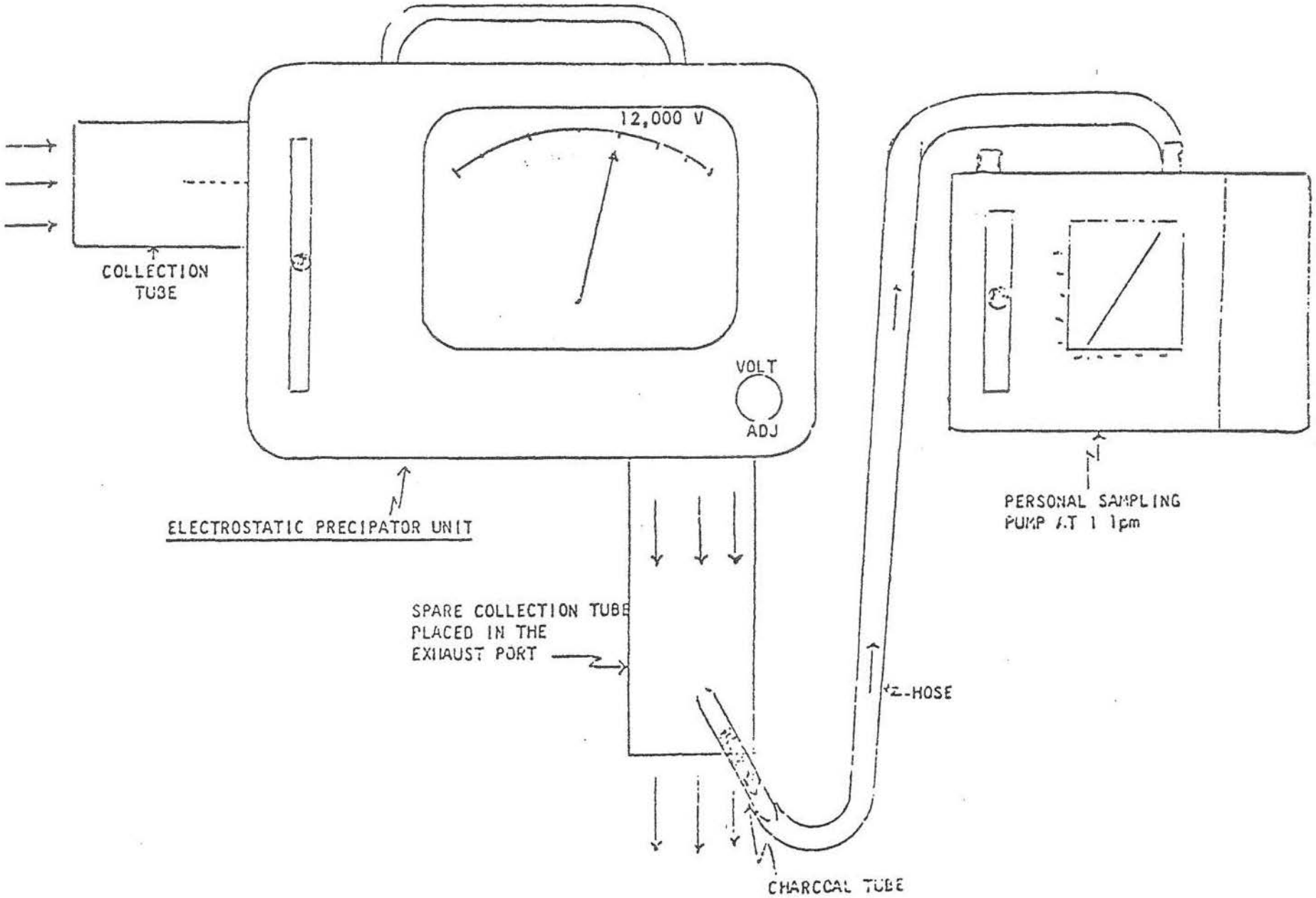
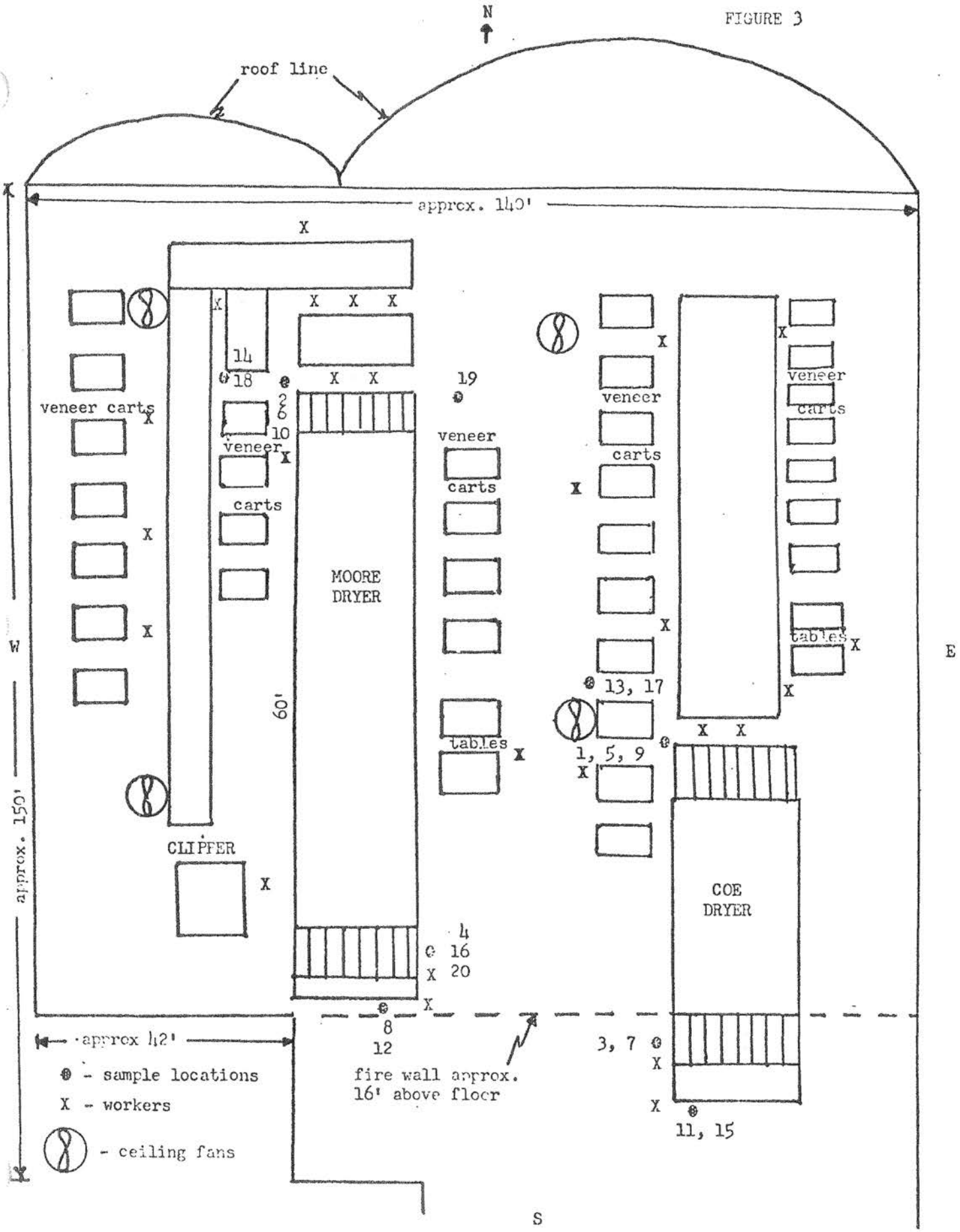


FIGURE 2. SAMPLING SCHEMATIC DIAGRAM

FIGURE 3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fire wall approx. 16' above floor
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tables
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1, 5, 9
COE DRYER
3, 7
11, 15
- sample locations
X - workers
- ceiling fans