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U.S. ASBESTOS & RUBBER DIVISION OF [illegible],

[illegible], Ga.

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A second survey of dust conditions in the Combin plant of the U.S. Asbestos & Rubber Division of Raybestos-Manhattan, Inc. was made on April 16, 17, 18, 22, and 23, 1953. This is supplementary to the survey conducted in February, 1950 and the methods of sampling and analysis are the same as in the first survey.

The first survey included only those departments involving textile operations, whereas this survey includes all departments of the plant.

The processes in the Preparation Department, Carding Department, Brake Hand Weave Room, and twisting, spinning, spooling, and braid cloth weaving departments are the same as at the time of the first survey. The exhaust equipment has not been changed.

The following tables show results of dust counts and comparative data of the two surveys:

U.S. ASBESTOS & RUBBER DIVISION OF RAYBESTOS-MANHATTAN, INC.

Manheim, Pa.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
PREPARATION DEPARTMENT, DEPT. #1							
1	Beside discharge pipe from vertical opener discharging fibre onto screen	4/16/35	20.0	6.2	5.15	Asbestos cotton	Stock 224 116 special
2	At loom #39 - wet warp	"	27.9	20.9	17.4	"	Only loom in Prep. Dept.
3	Between chasers #1 and #2	"	15.0	21.8	18.1	Asbestos	Shebani fibre #2, one man
4	Beside truck under discharge pipe from hopper on second floor	"	9.5	33.7	28.0	Asbestos cotton	One man, clothes covered with fibre
5	Floor mixing of asbestos and cotton between chasers and vertical opener	"	15.0	30.4	25.2	"	Three men
6	At discharge end of small fibre opener	"	20.5	10.2	8.5	Asbestos	Conveyor belt; one man, fibre from crusher
7	General air in preparation room	"	22.0	14.2	11.8	Asbestos cotton	Center of room
8	At hopper of mixing picker	"	15.0	21.8	18.1	"	One man, forking mixture into hopper from floor

Relative humidity in Preparation Dept. (1935) 20% - - (1930) 37%
The average of these counts is 19.9 million particles per cu. ft. air sampled.
The average count in this department in 1930 was 14.13 million particles per cu. ft. air.
The analysis of rafter dust from this department showed 36% SiO_2.
Relative humidity outside (1935) 50% - - (1930) 67%.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
CARD ROOMS							
9	At take-off end of breaker card #1, Dept. 2, 2nd floor	4/16/35	41.0	9.0	7.7	Asbestos cotton	
10	Taken between cards #9 and #16, Dept. 2, 2nd floor	"	20.5	13.7	11.7	"	129 mix - cards enclosed and exhausted
11	Between storage bins and cards #31 and #32 at operator's positions	"	31.1	18.8	16.0	"	Cards partially exhausted but not enclosed #32 - 130 stock #31 - 116 special
22	Same location as #11 just after stock from mixing picker had been blown into storage bins	4/17/35	36.5	16.2	13.8	"	Bin door opens on this floor
12	Between cards #1 and 2 and #7 and 8 operator's station, Dept. 3, second floor, 3 cards running 224 stock; 1 card running 124 stock	4/16/35	22.5	16.7	14.2	"	Cards partially enclosed and exhausted; operator wore gauze strip with cotton pad under nose.
13	Between cards #7 and #8 on saddle side; saddles extend out from enclosure	"	10.0	36.8	31.4	"	Dept. #3, second floor
14	Between cards #18 and 19 and #25 and 26 in aisle where operator works	"	20.0	28.4	24.2	"	Cards partially enclosed and exhausted; 3 cards running 224 stock 1 card running 60/40 stock
19	Between cards #20 and 21 and #27 and 28 in aisle where operator works; cards partially enclosed and exhausted	4/17/35	30.0	8.8	7.5	"	2 cards running 60/40 stock; 1 card running 231 stock; 1 card running 224 stock

Relative humidity 28%.
The average of these counts is 18.55 million particles per cu. ft. air sampled.
The average count in these departments in 1930 was 7.78 million particles per cu. ft. air sampled.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
SPINNING DEPT. #4, 2nd floor							
15	Between speeders twisting wire and yarn, 2 men	4/16/35	20.0	20.0	17.0	Asbestos cotton	Machines #464 463, 462, 459 229 stock - 224 stock
16	Between mules #417 and 402 where operators work	"	27.5	29.6	25.2	"	
17	Between mules #404 and 405 where operators work	"	20.0	12.4	10.5	"	
18	Between mules #406 and 407 where operator works	"	20.0	17.6	15.0	"	

Relative humidity 28%.
The average of these counts is 19.9 million particles per cu. ft. air sampled.
The average count in this department in 1930 was 2.72 million particles per cu. ft. air sampled

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
WEAVE ROOM (BRAKE BAND) DEPT. #12							
20	Between looms #3 and #23 dry weaving	4/17/35	30.0	14.9	12.7	Asbestos cotton	Ring stock and brake lining 224 stock one man
23	At operator's position of loom #17	"	23.3	14.8	12.6	"	Pontiac brake lining 224 stock
24	In aisle between looms #33 and #19, wet weaving	"	32.5	8.85	7.5	"	#33 - 224 stock #19 - 310 stock
25	In aisle between looms #14 and #26, and #7 and #12	"	23.0	7.3	6.2	"	#14 and #26 - truck lining - wet #7 and 12 dry - 224 stock
26	Inspection of brake lining and ring stock	"	30.0	6.15	5.2	"	Material goes thru revolving brushes - exhaust system

Relative humidity (1935) 47% - (1930) 76%
The average of these counts is 10.4 million particles per cu. ft. air sampled.
The average count in this department in 1930 was 6.9% million particles per cu. ft. air.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles less than 10 microns in greatest diameter per cu. ft. Air Sampled	Type of Dust	Remarks
SPOOLING, TWISTING & WEAVING							
27	Between looms #1 and 2 and #3 and 4; broad looms, #1 not running	4/17/35	49.0	8.8	7.55	Asbestos cotton	Air-water spray for humidifying, Dept. 10.
28	At looms #22 and 24, cloth	"	26.0	16.3	14.0	Asbestos cotton	#24 warp wet with a hose; #22 dry.
29	At loom #10 - wet weaving, 890 cloth, 3 ply for clutch facing	"	22.0	10.3	8.8	"	210 - 224 mix, warp passes through 634 emulsion
30	Between twisters #657 and 658	"	24.0	13.7	11.8	"	2 women, dept. 7.
31	Between twisters	"	26.6	18.0	15.4	"	2 women, dept. 7.
32	Between spoolers #3 and 4, dept. 6	"	20.8	25.0	21.4	"	6 women, dust on machines blown off with cardboard used as fans.

Relative humidity (1935) 41% - - - (1930) 50%
The average of these counts is 15.35 million particles per cu. ft. air sampled.
The average count in this dept. in 1930 was 2.35 million particles per cu. ft. air sampled.

CONCLUSIONS AND RECOMMENDATIONS

TEXTILE DEPARTMENTS

The dust counts in the Preparation Department are high. All counts, but one, show more than ten million particles per cubic foot. The raw fibre is handled carelessly and piled on the floor at various places. The average dust counts are higher than those of the survey made in 1933. No improvements have been made since the first survey was made. The relative humidity is lower than at the time of the previous survey.

It is recommended that a mechanical method of handling the fibre be installed. Exhaust equipment, properly designed and applied, be installed at the chasers, pickers, and shaker screens and it should be properly maintained. The cane loom should be removed from this department. A humidifying system should be used, if practicable. A vacuum sweeping system for sweeping and cleaning machines should be installed throughout the plant.

The average counts in the broke hand weave room are higher than those of the 1933 survey. No exhaust equipment is in use on the looms. The relative humidity is lower than at the time of the first survey.

It is recommended that wet warp weaving be done whenever possible. The humidity should be kept as high as possible without causing discomfort to the workmen.

The average dust counts in the spooling, twisting, and weaving departments are much higher than those of the first survey. The relative humidity is lower than at the time of the first survey.

It is recommended that the broad looms be exhausted and the humidity be kept higher.

The average dust counts in the spinning department are much higher than those of the first survey. This may be attributed to pollution of the air from the carding machines located in the same room and to the low humidity. A check of the records will show the grade of fibre used at the time of the two surveys and the rate of production.

It is recommended that the spinning department be isolated from the carding department. A humidifying system should be installed.

The average dust counts in the carding departments are higher than those of the first survey. A check of the records would show the grade of fibre used at the time of the two surveys and the rate of production. The exhaust equipment does not seem to be effective in removing the dust generated.

It is recommended that exhaust equipment, similar to that in operation at the Charleston plant, be installed on the carding machines. Fibre storage bins opening into the card room should be exhausted.

BRAKE LINING AND CLUTCH FACING

PROCESS

Two types of brake lining are made. One type is made from woven narrow bands of asbestos. The bands are saturated in an emulsion or a rubber solution according to specifications. They are cured in heated presses or on heated mandrels. If they are cured on heated mandrels, they are cut to length before being cured. The mandrels also shape them into arcs. They are ground to the thickness desired and rivet holes are drilled or punched into them. They are inspected and packed for shipment.

The second type of brake lining is the extruded type. This type is produced from a mixture of asbestos fibre, litherge, sulphur, zinc oxide, whiting, mica, and rubber dissolved in gasoline. This wet mixture is put into an hydraulic press and is extruded through a die into long narrow strips. The strips are cured in heated presses. They are ground to the thickness and width desired and formed on heated mandrels. Holes for rivets are drilled or punched into them. The ends are chamfered. The lining is then inspected and packed for shipment.

Clutch facing is made from asbestos cloth and narrow bands of woven asbestos. The wide cloth is cut into squares on a band saw. Solid rings are cut from these squares after they have been saturated in an emulsion and dried. The rings are cured in heated presses. They are then ground to the thickness desired. Holes are drilled into them on gang drill presses. The inside and outside diameters are ground on Gardner grinders. The clutch facing is then inspected before shipping.

The narrow bands of woven asbestos are put through a sewing machine to be formed into spirals. These are then put through a rubber solution and wound onto a mandrel. The rings are cut and the ends fastened together with brass wire. They are cured in heated presses and ground to the dimensions required. They are then inspected before shipping.

Folded Gaskets and Packing

Asbestos cloth is impregnated with a solution of rubber and gasoline. The cloth is then cut into strips. The strips are folded by hand roughly to form the gasket or packing. The rough forms are then placed in forming molds and pressed and cured in steam heated presses. The edges are trimmed and the product is then inspected.

Rubber used in the various products is compounded in building #2. The raw rubber is mixed with zinc oxide, lithopone and barytes in a rubber compounding mill. The compounded rubber is dissolved in gasoline in tumbler barrels.

The emulsions used in the various products are made in building #35. The materials used are litharge, lamphlack, mica, diluomite, linseed oil, turpentine, and water. These materials are weighed and put into an electric mixer. After the emulsion is mixed, it is put into pails and carried to the different departments where it is used.

ANALYSES OF BLOOD SPECIMENS

Name	Age	Occupation	Years of Exposure	Hemoglobin %	Punctate Basophiles	Remarks
Leo F. Blanch		Emulsion preparation	2	90	Frequent	Poor teeth
Harry L. Bullock		Grinding brake lining	5 (approx.)	86	Negative	
Samuel Wright		Mixing for extruded brake lining	1½	65	"	Stomach trouble
Charles Mattress		Cutting brake bands	4½	40	Occasional	Formerly mixing for extruded brake lining, changed because of sickness, had lead poisoning 2 years ago, treated by doctor
LeRay Geib	26	Ball grinder	1½	94	Negative	Complains of nervous disorders and stomach trouble, claims to have high blood pressure
Robert Guider	22	Extruder	3	60	"	
Louise Winger	20	Label and stamp segments	1½	70	"	
Mark Mohr	26	Segment grinder	2½	85	"	
E. F. Walter	40	Supt. of molded brake lining dept.	4½	55	"	
Olive Bauer	22	Label and stamp segments	1 1/3	70	"	
Annette Shanks	23	Label, stamp and ship segments	1 1/3	80	"	
Malcolm Shaffer	23	Braider	1	65	"	
E. Spessler	20	Mandrels	2	95	"	
John Miller	29	Rubber mixer	1½	97	"	
Homer Miller	30	Segment grinder	6 mos.	90	"	Worked 10 years previously as silk weaver
Paul H. Hollinger	25	Supervisor of molded brake lining	1	100	"	

CONCLUSIONS AND RECOMMENDATIONS

CLAYTON FACTORY, FRANK LINEY AND FACTORY DEPARTMENTS

Several dust counts in these departments are high and in almost all cases show that there is lead present in the air. Samples #34, #3, #3 and #5 show large quantities of lead present. Chemical analyses of refiner dust samples from these departments also show presence of lead. These analysis show that there is a definite health hazard present due to the use of lead. There is another health hazard present due to the use of benzol in the treating of brake heads.

Blood specimens were taken from sixteen employees and the results of these tests are shown in tabular form. Only two specimens showed punctate basophiles (stippled cells), but several other specimens showed low hemoglobin percentage.

It is recommended that a vacuum sweeping system be installed to do away with dry sweeping.

All machines in these departments should be equipped with efficient exhaust systems to carry away harmful dusts.

Employees engaged in handling lead should be supplied with positive pressure or cartridge type respirators and cautioned to handle the lead carefully. These operations should be isolated from the remainder of the departments. Female help work in the same room in which litharge is mixed for extruded brake lining. Empty litharge drums should be removed from the department.

The use of benzol should be eliminated, if practicable, or such operations should be isolated so that the least number of employees would be exposed to the fumes, or the benzol could be handled in a closed system.

The employees exposed to benzol fumes should be supplied with positive pressure respirators. All employees in these departments should be watched carefully and examined periodically for signs of lead or benzol poisoning.

Sample No.	Station	Date of Sampling	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft. Air Sampled	Millions of Particles, Less than 10 microns in greatest diameter per Cu. Ft. Air Sampled	Milligrams of Lead per Cu. Ft.	Milligrams of Lead per Cu. Meter	Lead Intake in Milligrams per 10-hr. day	Type of Dust	Remarks
CERTAIN FACING AND BRAKE LINING										
77	General air - Inspection of brake lining, dept. 777.	4/14/38	24.0	4.46	4.0	0.00117	0.0414	0.111	Asbestos lithorge rubber	4 c.cms - 2 cms
34	At outside grinder, dept. 777, brake lining	"	22.0	4.6	4.15	0.00021	0.798	2.00	"	Exhaust system
36	General air, sorting and cutting area on brake lining, dept. 778	"	20.3	14.2	12.6	0.00125	0.0441	0.111	"	Bored mandrels - 2 cms
35	At inside grinder, brake lining, dept. 778	"	23.0	13.5	14.0	0.0135	0.537	1.34	"	Exhaust system
39	At grinders 2277A and 2277, extruded brake lining, dept. 777	"	27.0	4.1	3.7	0.00021	0.0085	0.245	"	Exhaust system
38	Unloading materials for extruded brake lining hatchway, dept. 777	"	23.3	13.7	12.3	0.0140	0.588	1.48	Lithorge alum calcium zinc oxide cutting asbestos	Mine Safety Appliance respirator worn only while handling litharge and zinc, rubber discolored in gasoline.
30	At hand saw cutting asbestos cloth for cloth facings, cloth and fabric being treated	"	12.5	21.0	20.2	—	—	—	Asbestos cotton	4 cms cable cutter cable 1 cms worn respirator, dept. 77
40	General air - taken over heated gauge for curing brake lining, dept. 777	"	17.0	10.3	9.26	0.00024	0.0099	0.79	Asbestos rubber	
42	At fanner grinder 777 outside grinder, dept. 77	"	22.0	7.3	6.6	0.00132	0.0550	0.07	Asbestos litharge rubber	1 cms - exhaust system
48	General air - taken at heated process curing cloth facing	"	22.0	5.0	4.7	0.000	0.000	0.000	"	5 cms - dept. 77
43	At inside grinder 778, cloth facing, dept. 77	"	22.5	12.4	11.2	0.00013	0.0054	0.15	"	1 cms - exhaust system
45	Same as sample 43.	4/22/38	22.3	10.1	9.1	0.000014	0.0012	0.032	"	
46	Pinchpost grinder 2278, dept. 77 at operator's position	"	24.0	10.0	9.0	0.00073	0.0290	0.798	"	Exhaust system - 1 cms cloth facing
47	Drill 731, dept. 77, drilling holes in cloth facing	"	24.0	9.9	8.9	0.00132	0.0525	0.336	"	1 cms - exhaust system
48	Buffer grinder 714, dept. 77, grinding cloth facing, exhaust system	"	22.0	22.0	19.2	0.0010	0.037	0.07	"	Large particles thrown off - operator wears goggles
44	General air - cloth facing inspection dept. 77	"	22.0	7.6	6.8	0.00054	0.021	0.14	"	4 cms - 4 cms
49	Drying asbestos cloth bldg. 21	"	12.0	4.3	3.7	—	—	—	Asbestos cotton	1 cms - vent runs to rubber mix room
50	General air, rubber grinding dept. bldg. 21	4/23/38	27.9	21.0	20.7	0.000	0.000	0.000	Soapstone	1 cms - gasoline as solvent
51	At rubber mill, bldg. 21	"	22.0	22.0	20.5	0.000	0.000	0.000	Zinc oxide litharge carbon black	1 cms - no respirator
52	General air - between inspection of cloth and sorting cloth for gaskets, bldg. 21	"	22.0	3.3	2.8	—	—	—	Asbestos cotton	
53	Gasket dept. fitting gaskets over table bldg. 21	"	23.0	7.0	6.7	—	—	—	Soapstone	4 cms
54	General air, gasket dept. bldg. 21, cutting gaskets from rubber treated asbestos cloth	"	23.0	10.3	8.9	—	—	—	Asbestos rubber soapstone	10 girls
55	Mixing machine, bldg. 78, 2 cms, no exhaust, no respirators	"	20.0	27.4	25.7	0.0097	0.342	2.48	Litharge hydrated zinc oxide	Litharge hand scooped; linseed oil, kerosene, water

Chemical analysis of settled dust samples

Dust sleeve for extruded brake lining department 77 . . . 0.49% Lead
Dust rubber mill - bldg. 21 . . .17% "
Emeries department . . . 7.10% "

HEALTH HAZARDS OF ASBESTOS AND OTHER DUSTS

Asbestos dust gives rise to a pneumoconiosis or fibrosis of the lungs which has been discussed in the previous report made on the asbestos industry. Developments in our knowledge of asbestosis are continually taking place and a summary of new facts discovered will be added to the general composite report of the asbestos plant survey which is to be brought out later.

Mica dust. Very little is known of the effect of mica dust on the lungs, but such evidence as there is would tend to place it in a class with the less harmful silicate dusts such as talc and clay. If inhaled in sufficiently high concentrations, these dusts would have to be considered potentially harmful, however, until the contrary is proved, although they apparently do not have the specific injurious effect of the dusts high in uncombined silica.

With the exception of litharge, or lead, an extremely toxic dust, the other dusts generated in the compounding of rubber and brake linings such as zinc oxide, sulphur, and lithopone are probably relatively harmless in the quantities present and in any event proper protection against the lead or litharge dust which is essential would protect against these also.

TOXICITY OF LEAD

Lead poisoning is probably the most common of the industrial poisonings. Practically all forms of lead are toxic, the degree of toxicity depending upon their solubility in human tissues. The oxides and basic lead carbonate are among the most soluble and therefore the most readily toxic forms.

Lead inhaled is more rapidly and more surely toxic than lead ingested. When lead enters the digestive tract some or most of it may be eliminated unchanged from the body and it is only when it is absorbed in greater quantities

than are eliminated that poisoning occurs. When lead is taken into the lungs, it reaches the blood stream rapidly and directly and comparatively little is eliminated. While lead is circulating in the body poisoning may occur. Lead absorbed in excess of lead eliminated is accumulated in various organs and is finally deposited in the bones in insoluble form in a manner similar to the deposition of calcium. It is somewhat controversial at the present time whether or not under ordinary circumstances changes in bodily metabolism can later render the lead thus stored in the bones soluble again and set it free into the circulation causing poisoning without further exposure. It has been demonstrated by Aub and his associates,(1) however, that this stored lead can be released by medication with weak acids and low calcium intake. Aub's studies on the subject eight or ten years ago revolutionized the treatment of lead poisoning. Extensive studies on lead poisoning have also been made recently by Kehoe and his associates(2) who have made valuable contributions to the knowledge of the subject.

Lead absorption does not necessarily mean lead poisoning, but there is probability of lead poisoning wherever lead is being absorbed into the body. Individuals vary considerably in their ability to take in and eliminate lead. It is generally considered that negroes, women, and children are more highly susceptible and that those who have had attacks of poisoning are more liable to future attacks than those who have not.

With a few notable exceptions, industrial lead poisoning is of the chronic type due to prolonged exposure to minute quantities of lead taken in daily. Owing to the above-mentioned differences in the toxicity of lead compounds, in the methods of entrance into the body, and in individual susceptibility

(1)Aub, J.C., Fairhall, L.T., and others, Lead Poisoning, Medicine Monographs, Vol. VII, The Williams & Wilkins Co., 1926, Baltimore, Md.
(2)Kehoe, R.A. Thomas, Fred, and Chalek, Jacob, Lead Absorption and Excretion in Certain Lead Trades, Journal of Industrial Hygiene, Sept. 1933, Vol. XV, No. 5, pp. 306-319, Balt. Md., another article pp. 320-340.

ity, there is little agreement in the numerous attempts that have been made to estimate the minimum amount of lead which can cause chronic poisoning if taken in over long periods of time. The various estimates range from one-tenth of a milligram to ten milligrams daily. Probably one to two milligrams daily represents a fairly safe limit.

In a study made by the United States Public Health Service(3) in a storage battery plant, for instance, it was concluded that for the conditions of exposure in that plant, 1.5 milligrams per 10 cubic meters of air appeared to be a safe limit.

It is also impossible to determine exactly the amount of air taken into the lungs daily, owing to individual differences and to differences in degree of activity. For practical purposes only, therefore, it is roughly estimated that a man at moderately heavy work inhales about 10 cubic meters of air in a ten-hour day. Where possible, it is recommended that the working atmosphere should be kept below one-tenth of a milligram per cubic meter of air or the workers should be protected by suitable respirators and other precautions. Removing lead at its source of origin is by far the best method for prevention of poisoning.

Evidence of lead absorption is shown by an ashen pallor of the skin, a lead line on the gums, stippling of the red blood cells, and a secondary anemia or other indication of damage to the blood-forming organs. Upon evidence of lead absorption workers should be removed from exposure until all signs have disappeared.

If lead exposed workers are under very careful and experienced medical control, it is possible to catch every case of poisoning in the absorption

(3) U.S. Public Health Service, Treasury Dept., Public Health Bulletin No. 205, Lead Poisoning in a Storage Battery Plant, Gov. Print. Off. Wash. D.C., 1933.

stage or in the early stages of intoxication and, by taking appropriate measures, to prevent the occurrence of any acute or sub-acute attacks of poisoning. It is not easy, however, to diagnose lead in its early stages without laboratory studies of the blood, and there will generally be cases which will present symptoms unexpectedly and in an unusual manner.

The symptoms of lead poisoning are numerous and it manifests itself in a great variety of ways. The most common characteristic symptoms noted are colic, constipation, weakness, especially of the extensor muscles of the hands and feet, muscular pains, nausea and vomiting, loss of appetite, bad taste in the mouth, nervousness and irritability. The prominent objective signs of lead poisoning are pallor or jaundice, tremor, reflex changes, changes in the blood picture, excessive amount of lead in the excreta.

Lead intoxication brings in its train a great many sequelae, including paralysis, optic atrophy, encephalitis, and premature old age. It causes early degenerative changes such as arterio-sclerosis and nephritis. The mortality from chronic lead poisoning is not high, but this is absolutely no indication of the extent to which cases are occurring since cases treated early have a fairly good prognosis and since many deaths are recorded as due to the final sequelae such as arterio-sclerosis rather than to the original cause.

Among the measures for control of lead poisoning recommended by the industrial physicians of a large rubber manufacturing plant in Akron, Ohio are (1) monthly medical examinations of exposed workers, (2) separate lockers for work and street clothing, (3) provision of two sets of work clothing and arrangements for laundering weekly, (4) two respirators, one of them to be cleaned and sterilized each day, (5) provision of clean towels, soap and nail brushes, hot

running water, and time allowance for thorough washing, (6) wet sprinkling and sweeping or vacuum cleaning of the floor daily, (7) evacuation of all other workers except those engaged in operating local processes from the room, and (8) rules strictly enforced against eating in the workrooms.

TOXICITY OF BENZOL, ITS SUBSTITUTES, TOLUOL AND XYLOL, AND OF PETROLEUM DISTILLATES

Benzol is by far the most hazardous of the solvents commonly used in industry. It was at one time quite widely employed in many processes and especially in paints and lacquers used for coating by air guns, but because of its recognized danger to the health of operatives, its use has been largely supplanted by less toxic substances. The higher homologues of benzol such as toluol and xylol have been substituted in some cases with and in some cases without success from the health standpoint. These substances are more poisonous than benzol in high concentrations such as would result in acute accidents, and, experimentally, animals die in a shorter time and with lesser concentrations than is the case with benzol. However, their lower volatility gives toluol and xylol an advantage over benzol for industrial practice with respect to health of the workers and the effects of chronic poisoning; by toluol not containing any benzol seem to be less serious and not so lasting.

The Benzol Committee of the National Safety Council[1] found that benzol would cause signs of poisoning at concentrations of only 100 parts per million in the atmosphere. Slight effects are possible with even far lower concentrations. It should be borne in mind that benzol can also be absorbed into the system through the skin and that it is extremely dangerous to spill it on the skin or clothing.

The symptoms of chronic benzol poisoning resemble those of [illegible]

[1] National Safety Council, Final Report of the Committee on Benzol, Chemical and Rubber Section, Chicago, 1925, pp. 117-118.

over a period of time to low concentrations of benzol vapor are well known and consist of headache, dizziness, weakness, loss of appetite and weight, sore gums, shortness of breath, and, sometimes, abdominal pain, nausea and vomiting. The signs, with due allowance for atypical cases, generally consist of a marked reduction in the number of white blood cells, a changed relationship between the percent of polymorphonuclear cells and the lymphocytes, and later on pallor, due to aplastic anemia, oxygen want or internal asphyxiation, prolonged coagulation time, bleeding from the mucous membranes, purpura, and sometimes tremor and visual disturbances.

Besides the serious systemic effects, benzol, in common with many other solvents, may cause a dermatitis of the skin.

Individual susceptibility to poisoning by benzol appears marked. The fact that cases of poisoning are not being reported from workers in a given process is no guarantee of safety unless physical examinations with blood counts are carried out on employment and regularly during exposure. The symptoms are vague, the worker frequently is not aware of his exposure, and the family physician is usually not familiar with the manifestations of chronic benzol poisoning.

The National Safety Council committee has recommended that a 25% reduction in the white cell blood count should be considered as evidence of poisoning. The color index of the blood is not a reliable criterion, since destruction of red blood cells usually occurs fully late in the picture after serious or fatal damage has been done to the blood forming organs. Other conditions may be present which could cause a picture somewhat similar to that of benzol poisoning, in which case detailed study and observation are indicated. (5)

(5)McCord, Carey P., M.D., The Present Status of Benzene (Benzol) Poisoning, Journal of the American Medical Association, July 27, 1929, pp. 289-293.

The National Safety Council committee found that 30% of the exposed workers who were examined in various factories had leukopenia (decreased white blood cells) in mild or pronounced degree even when benzol concentration in the air was low and exhaust ventilation was good.

Preventive measures in handling so dangerous a substance logically consist of completely enclosing processes or containers and in providing carefully designed downward-draft ventilation, the results of which should be checked by air sampling. The method of choice, however, is to substitute some other less harmful substance where possible.

TOXICITY OF GASOLINE AND KEROSENE

In the presence of heavy fumes from these petroleum solvents, an acute anesthetic poisoning occurs with headache, blurring of vision, mental confusion, dizziness, nausea, and loss of consciousness. Permissible maximum concentrations[6] in the air breathed are estimated to be from 1000 to 2000 parts per million for short exposures and 1000 parts per million or less for prolonged exposure.

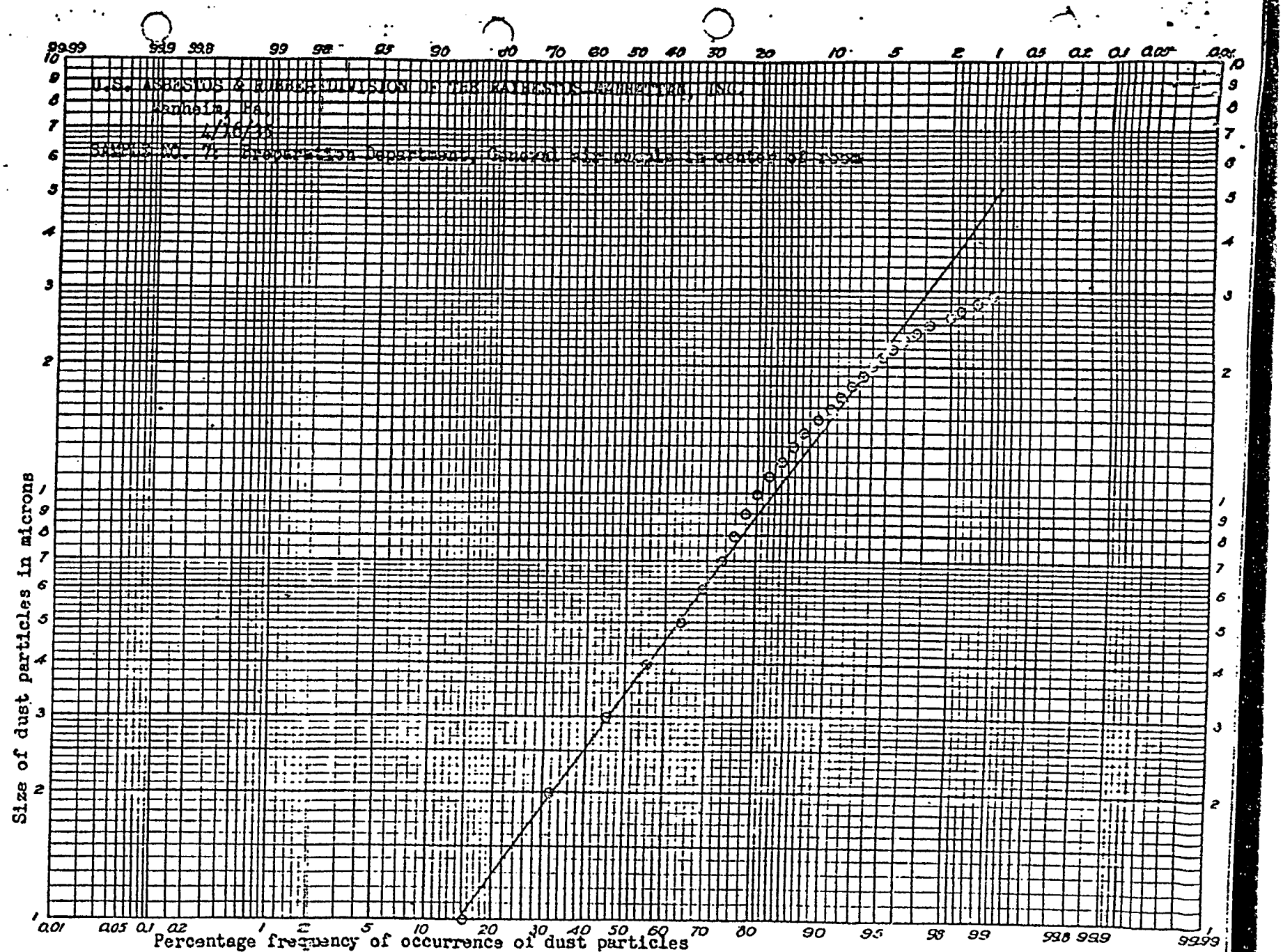
These substances are fat-solvent and skin trouble is frequently caused in those who come into continuous contact with them. Gloves are apt to aggravate the difficulty since without free evaporation, burns are caused by the gasoline getting inside the gloves. A booklet describing precautions to be taken against oil dermatitis is enclosed.

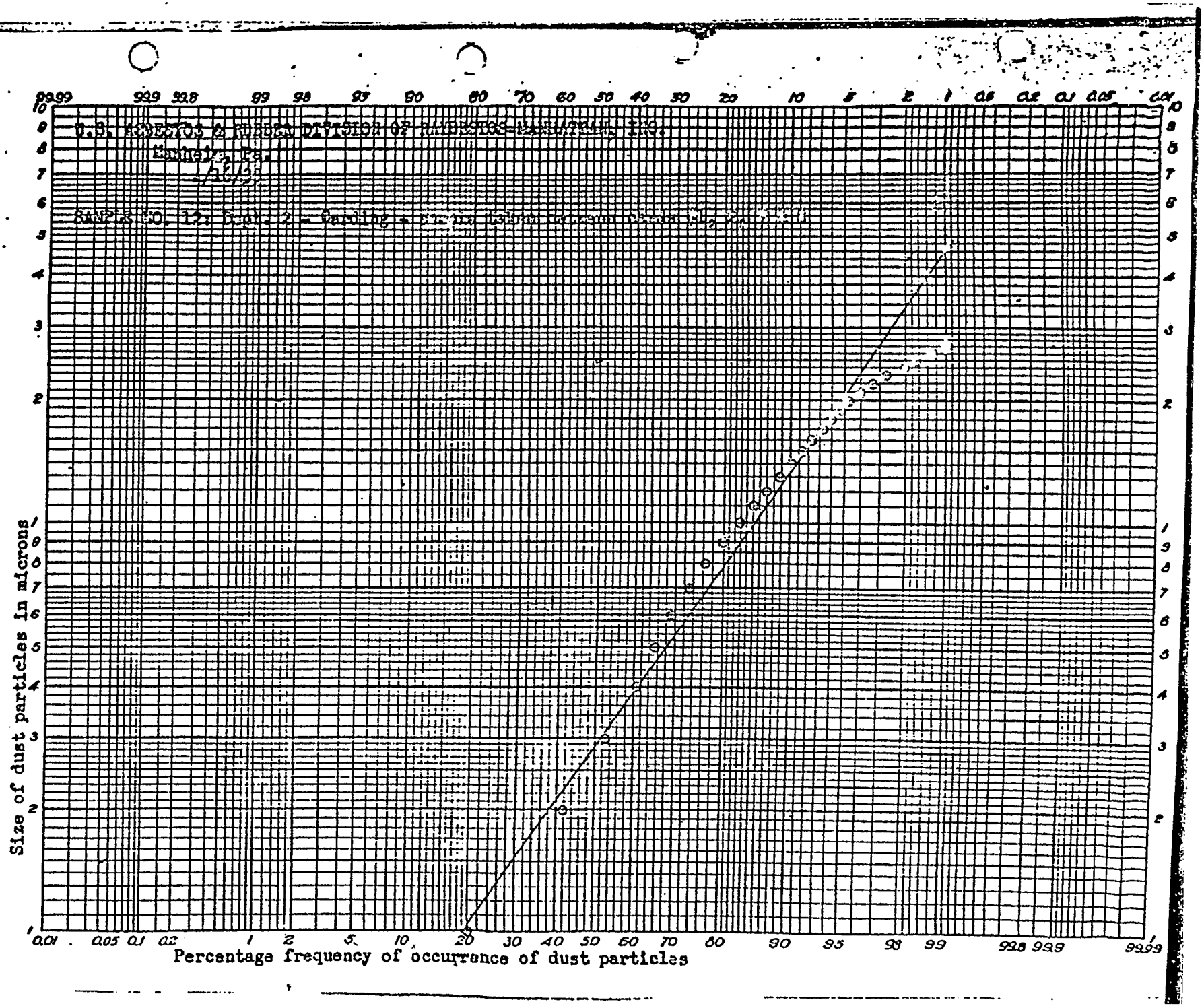
TOXICITY OF LINSEED OIL

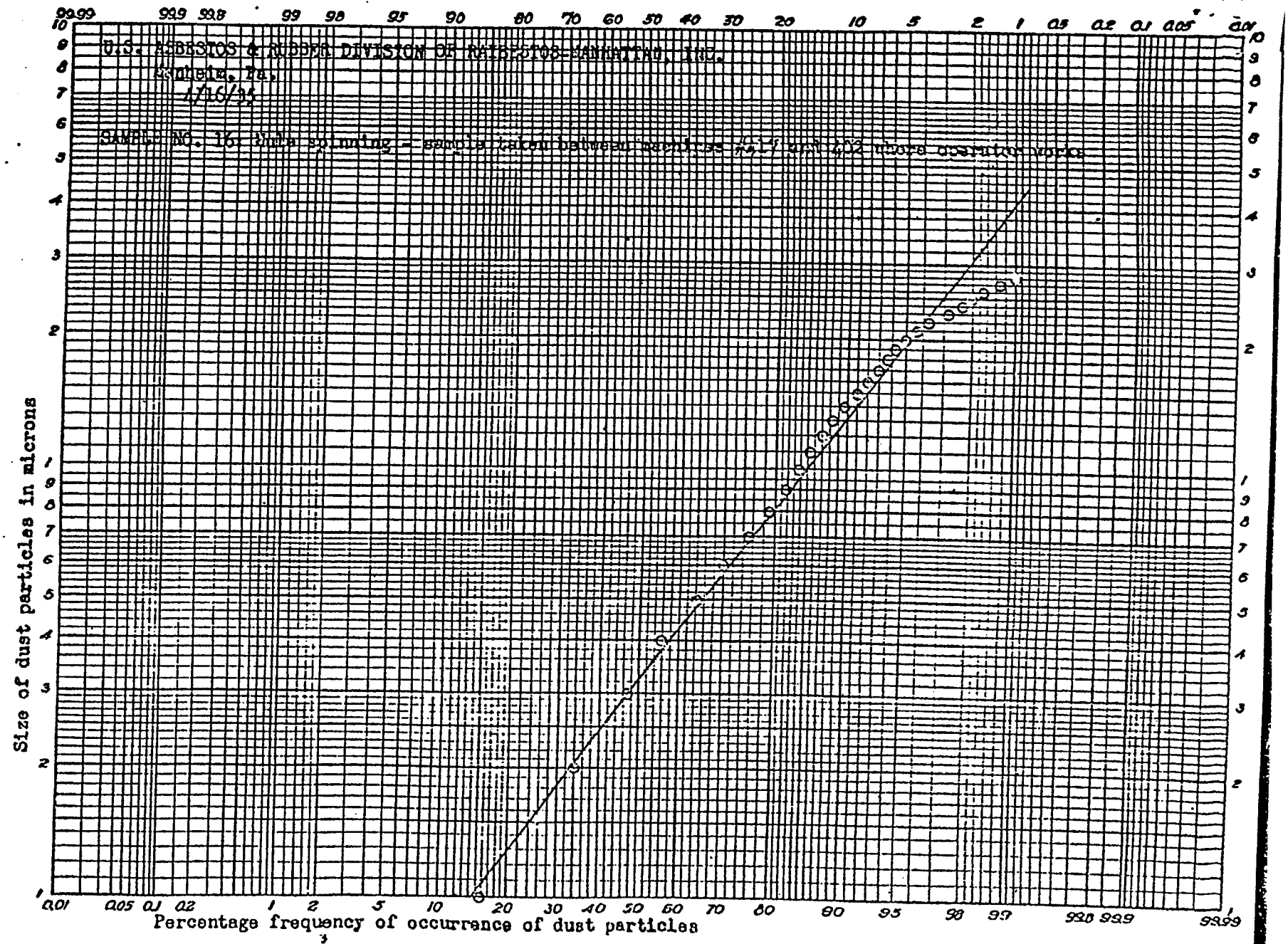
In addition to the danger of spontaneous combustion, linseed oil, when heated gives off irritating fumes of acrolein which may be acutely toxic in concentrations of more than 20 parts per million of air, while for prolonged

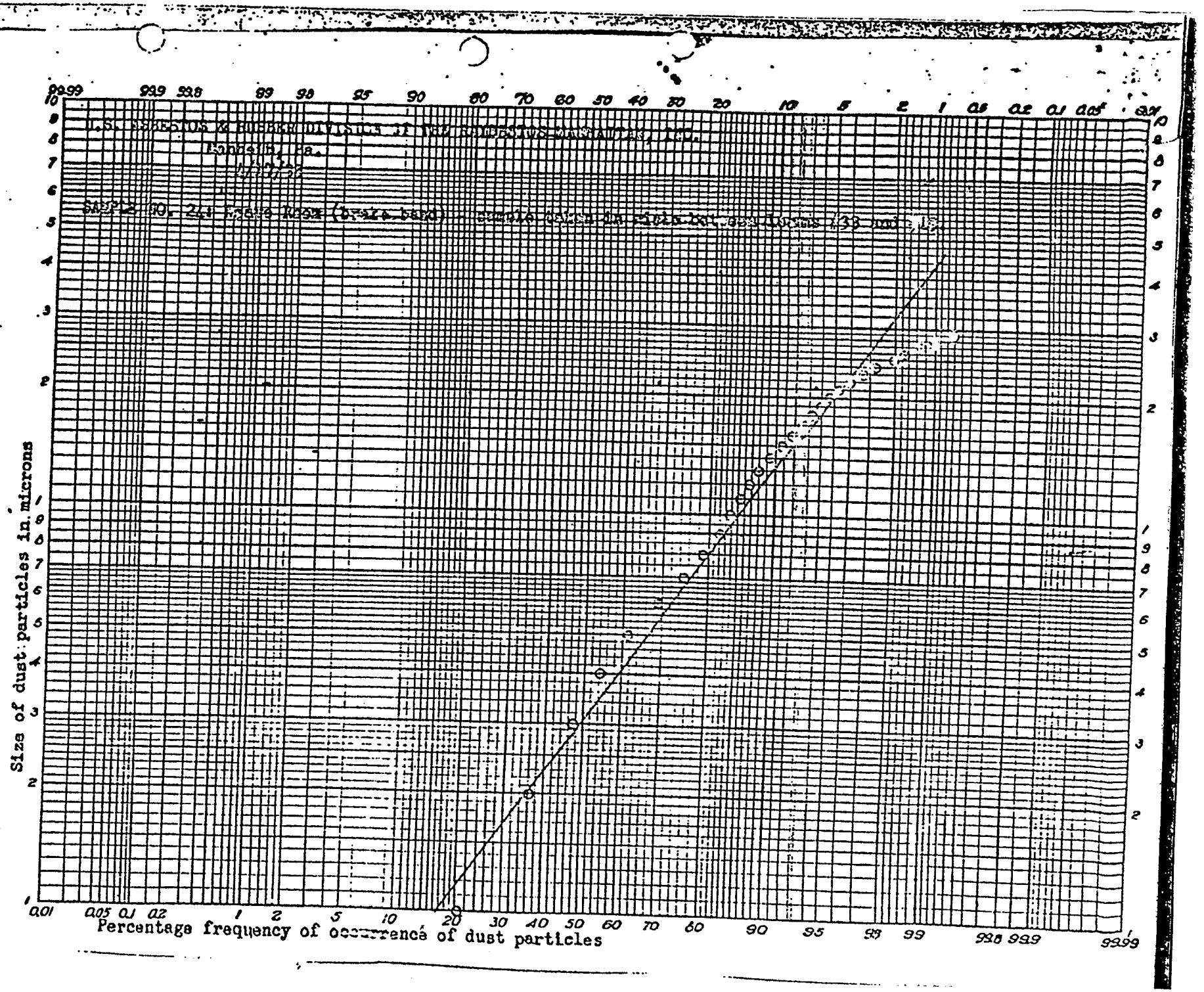
(6)U.S. Bureau of Mines

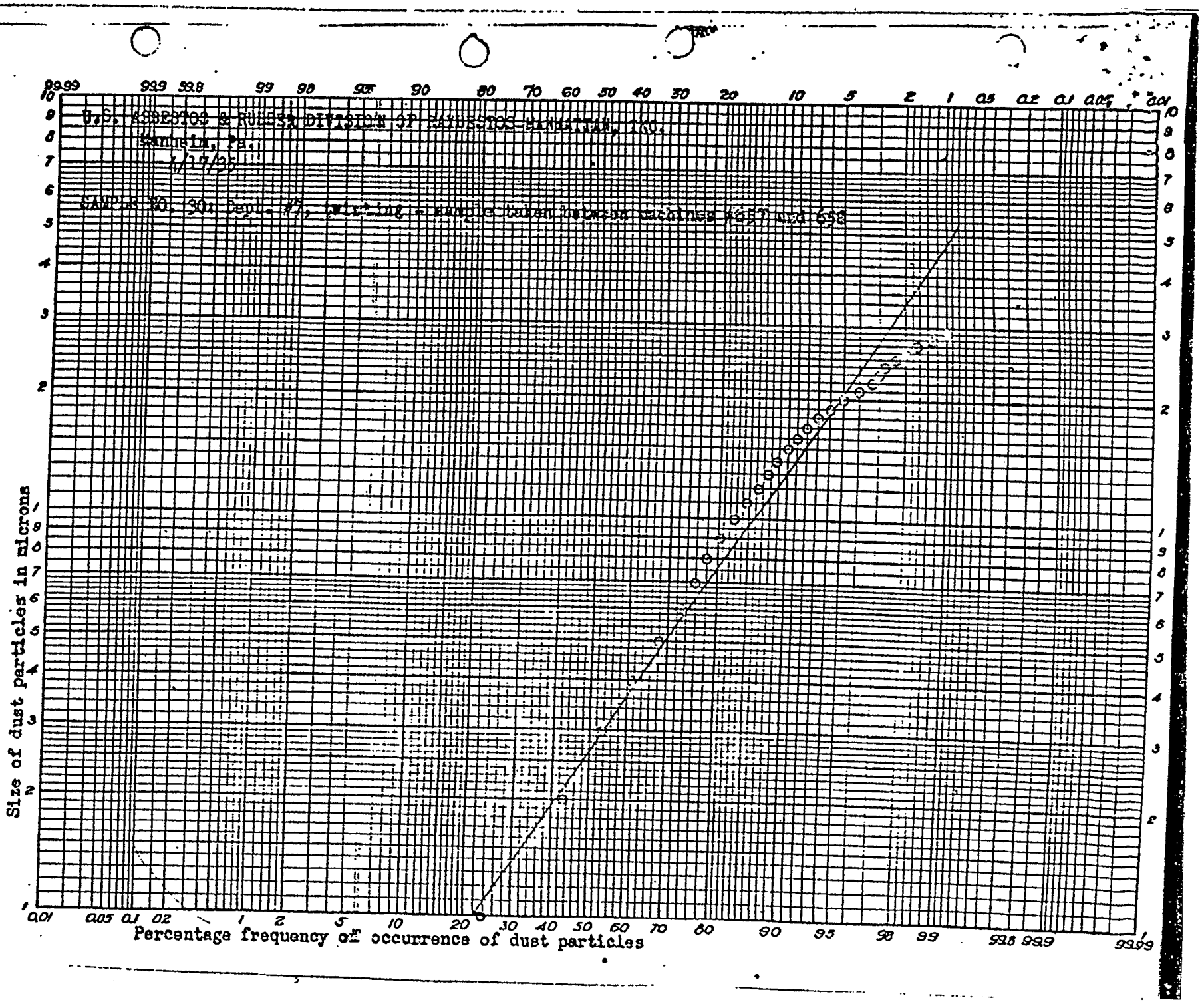
exposures 3 parts per million is considered the maximum permissible by the United States Bureau of Mines. No chronic ill-effects have been noted from this substance as used in industry, though it is irritating to the eyes, nose and throat. In addition dermatitis or infections of the skin are common among workers handling these oils. Those showing hypersensitivity are best removed from contact with them.

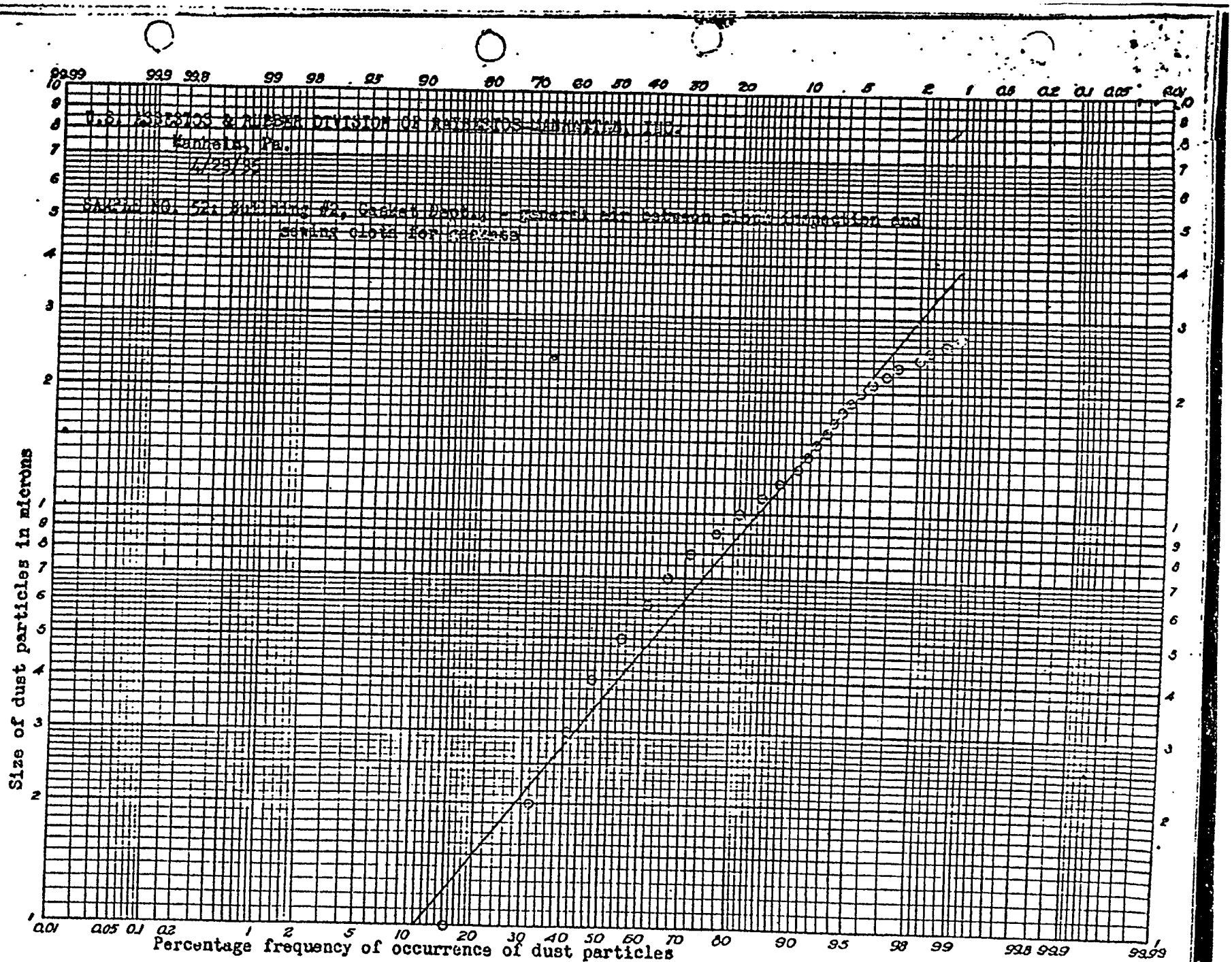

U.S. ASBESTOS & RUBBER DIVISION OF THE KAYBESTOS-MANHATTAN, INC.
Manheim, Pa.
4/16/56
Sheet No. 71 Preparation Department, General air sample in center of room
Size of dust particles in microns
Percentage frequency of occurrence of dust particles

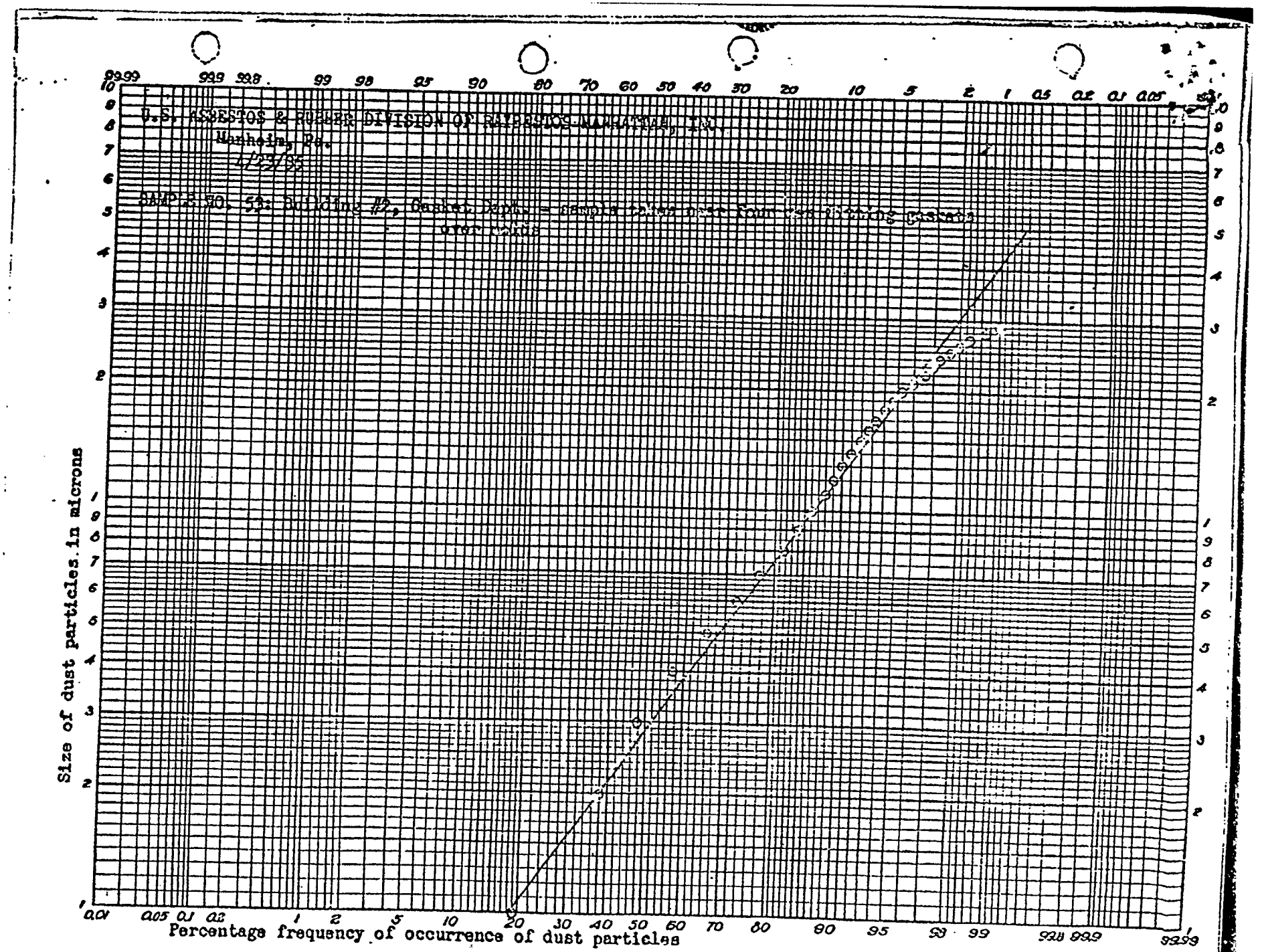

Size of dust particles in microns
Percentage frequency of occurrance of dust particles


U.S. ASBESTOS & RUBBER DIVISION OF RATH-STOSS-MANHATTAN, INC.
Camden, Pa.
4/16/35
SAMPLE NO. 16: Ruba spinning - sample taken between machines #21 and #22 where operator works
Size of dust particles in microns
Percentage frequency of occurrence of dust particles


Size of dust particles in microns
Percentage frequency of occurrence of dust particles


U.S. ASBESTOS & RUBBER DIVISION OF RAYBESTOS-MANHATTAN, INC.
Sample in, Pa.
1/17/52
SAMPLE NO. 30a Dept. #7, Grinding - sample taken between machines #657 and 658
Size of dust particles in microns
Percentage frequency of occurrence of dust particles
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
10 9 8 7 6 5 4 3 2 1
0.01 0.05 0.1 0.2 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99


U.S. RUBBER CO. & RUBBER DIVISION OF RESEARCH (ARMY-AF), INC.
Kunkels, Pa.
4/29/55
Sample No. 52: Burning #2, Cracked Deadman - Cement Mix Cannon Connection and Sewing Cloth for Cracked
Size of dust particles in microns
Percentage frequency of occurrence of dust particles


U.S. ASBESTOS & RUBBER DIVISION OF RAYBESTOS-MANHATTAN, INC.
Manheim, Pa.
1/23/85
SAMP. # 30. 5%: Building #2, Basket, Depth = sample taken over four feet from top of Casing
Size of dust particles in microns
Percentage frequency of occurrence of dust particles

Box 11.

DMC-347
J.T.
4/19/79

UNITED STATES ASBESTOS DIVISION

of Raybestos-Manhattan, Inc.

Manheim, Penna.

* * *

A survey was made of this plant on March 14, 15, 16, 17, 20, 21 and 22, 1939. This report supplements reports made on similar surveys conducted in 1930, 1935, and 1938.

The manufacturing operations at the time of this survey were the same as in the previous surveys. A few changes have since been made in the relocation of machines and in the application of exhaust systems for the collection and removal of generated dusts. Such changes are noted in the remarks column in the following tables of results.

The same sequence of sample numbers has been followed as in the previous reports.

Exhibit L

U. S. ASBESTOS DIVISION OF RAYBESTOS-MANHATTAN, INC.

Manheim, Penna.

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Total Count of Millions of Particles per cubic foot of air sampled	Type of Dust	Remarks
1	Preparing or opening room area of vertical opener and shaker screen; machines #19 and 39	3/15/39	38.0	8.0	Asbestos	The exhaust fan in similar under hood has been lowered to 4 feet from the floor and its capacity increased Approximately half the batch mixing is done outside the hood.
2	At operator's position on loom #946	3/16/39	46.0	5.2	Asbestos and cotton	This position is near the chasers which are being enclosed and exhausted.
4	Between #1 and 2 chasers; machines #2 and 3	3/14/39	56.0	4.0	Asbestos	These chasers are being provided wit exhaust hoods.
6	At loading end of tandem vertical opener; machine #15	3/15/39	56.0	5.2	Asbestos and cotton	
3	At discharge end of tandem vertical opener; machine #46	3/15/39	45.0	2.5	"	The exhaust hood has been extended to cover the conveyor and truck into which the material drops.
5	General air sample taken at center of the opening room	3/15/39	44.0	1.6	"	The additional looms placed in this department were not in operation when this sample was taken.
7	At Williams crusher	3/15/39	38.0	2.6	"	No waste material on the floor at the time this sample was taken.
9A	At Giant cutter	3/15/39	36.0	3.0	"	Sample #9 was take at the picker which has since been eliminated. No exhaust applied to this machine. The material discharges onto the floor.

Sample No.	Location of Sample	Date	Cu. ft. Air Sampled	Total Count of Millions of Particles per cu. ft. air sampled	Type of Dust	Remarks
	Card rooms - 2nd floor, dept. 3	3/21/39	42.0	1.5	Asbestos and cotton	The exhaust system on the cards is the same as in 1938.
8	At operator's position, cards 1, 2, 7 &8					
10	Condensing machine #360	"	44.6	2.5	"	No bagging of material at time this sample was taken. Exhaust hood applied over loading trucks.
12	Dept. 2 Between cards 1 and 7, machines #232 and 242, at take-off side.	3/20/39	42.0	1.7	"	
14	Between cards 7 and 13, machines #232 and 242, saddle side.	"	44.0	2.6	"	
11	Between cards 3 and 9, machines #255 and 261, at take-off side	"	42.0	3.0	"	
13	Between cards 9 and 15, machines #234 and 248, saddle side	"	43.5	1.7	"	
16	Between cards 5 and 12, machines #257 and 263, take-off side.	"	43.5	2.3	"	
15	Between cards 12 and 18, machine #264, saddle side	3/21/39	43.5	1.8	"	
17	Between cards 16 and 22, machines #266 and 270, take-off side.	3/20/39	35.6	1.8	"	
18	Between cards 13 and 20, machines #258 and 267, take-off side.	"	36.0	2.2	"	
19	Between cards 17 and 23, machines #271 and 276, take-off side.	3/21/39	51.5	1.1	"	
	Mule Spinning Dept.					
20	Between mules 1 and 2	3/17/39	29.0	2.7	"	
21	Between mules 5 and 6	"	34.0	2.7	"	
22	At Whitin spoolers, machine #418	"	34.0	3.2	"	Both Whitin spoolers now enclosed and exhausted.

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Total Count of Millions of Particles per cu. ft. air sampled	Type of Dust	Remarks
	Spooling, Twisting and Weaving 1st floor					
26	Between twisters, machines #657 and 658	3/16/39	34.0	2.6		
27	Between twisters, machines #651 and 652	"	44.0	2.6		
40	At spoolers, machines #603 and 613	"	42.0	3.6		
28	At Universal winders	"	36.0	1.8		
29	At looms 4 and 2; machines #1026 and 1021, operator's position	3/17/39	43.5	3.4		
30	At looms 11 and 10, machines #1031 and 1028	"	34.0	1.4		Loom #10 not operating.
31	At looms 6, 7, 8 and 9; machines #1013, 1032, 1040 and 1041	3/16/39	43.5	3.3		Loom #8 not operating; water sprays shut off; dry weaving.

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Total Count of Millions of particles per cu. ft. air sampled	Type of Dust	Remarks
Brake band weave room						
32	At looms #9 and 10	3/17/39	28.0	4.9		Warp is treated with emulsion.
33	At loom #2, machine #922	"	46.5	2.5		Wet warp weaving.
34	Between #33 and 19 looms; machines #939 and 925.	3/14/39	44.0	1.1		Loom #19 - warp is treated with emulsion loom-#33-not-operating.
36	Between #14, 26, 7 and 12 looms	3/17/39	63.0	4.7		Only #12 loom operating with warp passing through water.
35	At inspection table	3/14/39	42.0	2.3		Inspecting regular brake band lining, exhaust over brush.

LEAD ANALYSES

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Milligrams of Lead per Cu. Meter	Lead Intake per 10-hr. day	Remarks
35A	At inspection table	3/17/39	42.0	0.148	1.48	
33A	At loom #24	3/14/39	44.0	0.126	1.26	

LEAD ANALYSES

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft.	Milligrams of Lead per Cu. Meter	Lead Intake per 10-hr. day	Remarks
	Brake lining finishing dept.						
42	At calendering machine	3/21/39	33.6	1.7	0.085	0.85	
44	At sanding machine	"	34.6	2.6	0.102	1.02	
47	At drill press	3/22/39	37.4	5.3	0.074	0.74	
43	Machine shop - general air	3/21/39	43.5	1.5	0.07	0.7	
37	Emulsion mixing dept.	3/21/39	17.0	2.4	NEGATIVE		

LEAD ANALYSES

Sample No.	Location of Sample	Date	Cu. Ft. Air Sampled	Millions of Particles per Cu. Ft.	Milligrams of Lead per Cu. Meter	Lead Intake per 10-Hr. Day	Remarks
	Clutch Facing Dept.						
50	At Campbell cutter, machine #2321	3/22/39	34.0	4.3	NEGATIVE		
51	At Campbell clutch facing segment cutter, machine #1156	"	35.6	2.5	0.06	0.6	Exhaust applied to this operation.
52	Hand sanding tables	"	27.0	5.0	0.261	2.61	9 women now working as compared with 5 in 1938.
53	Dept. B59 - center of mandrels	"	31.0	2.2	0.07	0.7	
54	Pratt and Whitney surface grinder, machine #2340	"	34.2	5.6	0.124	1.24	This machine exhausted.
57	At Gardner grinder #14, machine #1566	"	29.6	8.8	0.07	0.7	This machine exhausted; at times pieces being ground are too large for hood and the operator then raises the hood, defeating the purpose.
58	At Blanchard grinders machines #1579 and 1675	"	27.3	9.3	0.459	4.59	
60	Between Gardner grinder #7½ and #2 drill, machine #1598	"	42.0	3.1	0.233	2.33	The dust collector now located outside the department.
62	Drilling machine #2346 and 1654	"	48.0	1.8	0.089	0.89	This machine exhausted.
63	Segment grinding, machine #2257	"	42.0	2.8	0.304	3.04	This machine has been relocated and exhausted since 1938 survey. Formerly sample #49.
64	Yates sander, machine #783	"	40.8	2.9	0.138	1.38	This machine exhausted.

CONCLUSIONS AND RECOMMENDATIONS

The dust concentrations are comparable to those found in the 1938 survey.

Lead concentrations in general are lower. This may be due to increased efficiency of exhaust systems or the material being worked may have a lower lead content.

It is suggested that the present program of extending and improving exhaust equipment be continued.