FILE NAME: Maryland Casualty Company (MCC)

DATE: 1937 June 1

DOC#: MCC017

DOCUMENT DESCRIPTION: Engineering Manual for Use in Legal Case, with 1982 Cover Letter

Amy Wilkenson
has replaced
Margaret Enloe

Ct Clerk
(215) 597-7704
~~Giles~~
597-0692
Amy Wilkenson

8613 U.S. Courthouse
601 Market Street
Phila., PA 19106

September 17, 1982

Mr. Patrick Burns
Law Offices of Kenneth L. Knapp
695 Town Center Drive
Suite 1000
Costa Mesa, CA 92626

Dear Mr. Burns:

Enclosed is a copy of the 1937 Engineering Manual which you requested. As we discussed, this document is one of the exhibits pertaining to a case currently pending before The Hon. James T. Giles in the Eastern District of Pennsylvania, CA-81-2129.

I will appreciate your forwarding a check to me at your earliest convenience in the amount of $10.50 to cover the cost of copying and handling. The check should be made out to the Federal District Court, E.D.Pa.

Thank you for your patience in this matter.

Sincerely,

Margaret A. Enloe

Margaret A. Enloe
Law Clerk,
The Hon. James T. Giles

att.

INTRODUCTION

THIS manual on occupational disease hazards and inspection procedure has been prepared for the sole use of employees of The Employers' Group. While in the possession of any employee, it is to be maintained in good condition and kept up-to-date by the revision and correction pages that will be issued from time to time. Upon the termination of employment with The Employers' Group, the employee to whom this manual is charged must return it to his immediate superior. Loss of this book will require a payment of $5.00 by the person to whom the book is assigned.

It is not intended that this manual will be a complete story of occupational disease or hazards. Obviously, it would require a book of some size to present this subject in complete detail. Neither is it intended that the information with regard to any hazard or industry explained in this manual is all that can be said about that hazard or industry. The idea of presenting the material contained herein is to give you a general outline of uniform procedure, and direct your thoughts and inspection methods to the most important phases of the subject. You already have considerable information and literature upon this subject, and the present manual will serve to supplement and consolidate that information.

The first portion of this manual gives a general discussion of the principal occupational disease hazards, together with generally accepted methods of control. This is followed by more detailed information with respect to dust hazards and information about the various toxic gases, vapors, and solvents.

The balance of the manual is given over to a discussion of individual workmen's compensation classifications subject to occupational disease hazards, together with a discussion of the individual industries. The industries and classifications have been grouped according to the various schedules which bring together industries of similar types or industries with similar hazards. If a risk is known by its classification number, it can be quickly found by referring to the schedule number. If the risk is known only by its classification description, it can be found by ascertaining the schedule number under which it is included.

All occupational disease inspections are to be reported on the special occupational disease hazard report which has the form number G 964 Rev. It should be kept clearly in mind that this form is essentially a guide to follow, and it may not necessarily provide enough room to accommodate all of the information that should be gathered in any particular risk. While unnecessarily long inspection reports are not wanted, it is absolutely essential that the hazards, exposure and condition of each risk be given in sufficient detail so that the Home Office can competently pass on the merits of each case. For this reason the reports should be accompanied by manuscript sheets that thoroughly cover all important parts of the inspection results. It is of particular importance that the individual hazards be detailed by departments; that the number of employees exposed to each hazard in each department be given in complete detail; that a complete statement is given of corrective measures already in use and those that you have recommended, and there should be given the general attitude of the assured. It should be borne in mind that the real purpose of the report is to give a complete picture of the hazardous operations to a person or persons who have never seen this particular plant.

Inspection work of this kind requires common sense, accuracy and care in reporting conditions as they actually exist. Reports that are submitted as a result of superficial inspections or poorly-formed opinions are valueless. Recommendations that are poorly conceived or that are not based on facts or the existence of real hazards, can not only result in high expense to an assured, but may aggravate the conditions for which correction is desired. Be careful that recommendations to prevent an occupational disease hazard do not introduce a fire or accident hazard. If you are not sure as to what should be done in any particular instance, report the details immediately to the Home Office.

It is of particular importance that close contact be maintained with the Claim and Underwriting Departments. Investigations of real or alleged occupational disease claims should be confined to engineering matters. All questions of medical examinations or treatment of existing employees of an assured should be referred to the Claim Department, and not discussed with an assured.

Occupational disease hazards of various kinds do exist beyond any question of doubt. At the same time these hazards can vary greatly in frequency and severity of occurrence. In all instances where individuals are concerned there is the question of individual susceptibility which may cause one to be misled. The fact that certain individuals have worked in a condition or location for a period of years that appears to be extremely hazardous, without any apparent ill effects, is not a sign that no hazard exists. Certain individuals with greater physical resistance, or possessing natural or acquired immunity may work for years in a location which would be extremely dangerous for another individual. This condition is apt to exist in smaller shops where not enough men are employed to give a good general average. In the same way, some people are overly susceptible and the wrong impression might be obtained as to the actual hazard in any industry, due to one or two cases in one small shop. However, it is necessary to consider the occupational disease hazards as they concern the very susceptible person. From an engineering standpoint, it is necessary to make sure that the dust, fume or gas concentration is maintained at such a point that no one is affected. It is not sufficient to maintain working conditions so that only ten or fifteen per cent of those exposed are affected.

Events of the past few years have demonstrated that with respect to the entire subject there has been much misinformation passed around and a tendency to either overemphasize or underemphasize the seriousness of these hazards. The matter has been further complicated by the existence of "rackets" and, oftentimes, false claims. From an engineering standpoint, the only view to take is one that can be based on facts as they are known to exist, and avoid misrepresentation.

SCHEDULE NO.	INDUSTRIES
1	Agriculture
2	Mining and oil or natural gas producing
4	Quarrying, stone crushing and sand or clay digging
5	Food and tobacco
6	Textiles
7	Cloth products
8	Laundries
9	Leather
10	Rubber, composition and bone products
12	Paper and pulp, paper products, and printing
14	Wood
16	Metallurgy
17	Metal forming
18	Machine shops, fine machines and instruments
20	Vehicles
21	Stone products
22	Clay products
23	Glass products
24	Chemicals
25	Miscellaneous manufacturing
26	Miscellaneous construction
27	Erection
28	Shipbuilding
29	Maritime operations
30	Stevedoring and freight handling
31	Railroad operations
32	Cartage and trucking
33	Public utilities
34	Commercial enterprises
35	Clerical and professional occupations
36	Operation and maintenance
37	Miscellaneous occupation

CLASS NO.		SCHEDULE NO.	CLASSIFICATION
0106		1	Tree pruning, spraying, etc.
0301		24	Turpentine or resin manufacturing
1147	Mo. Only	2	Lead mining — with shafts, tunnels or drifts
1148	Wisc. Only	2	Lead or zinc mining
1149	Okla., Kans., Mo.	2	Lead or zinc mining — with shafts, tunnels or drifts
1154	Tenn. Only	2	Lead and zinc mining
1164		2	Mining — NOC — not coal — with shafts
1165		2	Mining — NOC — not coal — surface
1413	Cal. Only	16	Refining of metal — not iron or steel
1430		16	Smelting, sintering, refining — lead
1437	Cal. Only	16	Smelting or sintering — NOC — not iron
1438		16	Smelting, sintering or refining — metals
1452		16	Ore Milling
1463		24	Asphalt works — grinding, pulverizing or mixing asphalt
1472		24	Distillation — wood
1604	(Col., Ga., Ind., N. Y., Tenn., Texas, Vt.)	4	Quarries — dimension stone
1605		26	Rock excavation
1622	Cal. Only	4	Quarry — NOC
1624		4	Quarry — NOC
1639		4	Slate splitting — including quarrying
1654		4	Quarries Cement rock
1701		21	Cement Mfg.
1703		21	Plaster Mills
1710		4	Stone crushing — no quarrying
1741		21	Flint or Spar grinding
1745		21	Soapstone or soapstone products manufacturing
1747		21	Emery works
1748		21	Abrasive wheel manufacturing
1803		21	Stone cutting or polishing — NOC
1852		21	Asbestos goods manufacturing — including spinning and weaving
1853		21	Mica goods manufacturing
1860		12	Abrasive paper or cloth preparation
2000	Cal. Only	5	Bakeries
2001		5	Cracker Manufacturing
2002		5	Macaroni Manufacturing
2014		5	Milling of grain
2016		5	Breakfast food manufacturing
2020	Cal. Only	5	Molasses or syrup refining — not glucose
2021		5	Sugar refining
2030		5	Beet sugar manufacturing
2041		5	Confectionery manufacturing
2042		5	Chocolate or cocoa manufacturing
2045		5	Chewing gum manufacturing
2081		5	Butchering
2089		5	Packing houses
2095		5	Meat products manufacturing — NOC

CLASS NO.	SCHEDULE NO.	CLASSIFICATION
2101	5	Fish curing or packing
2260	6	Wool combing or scouring
2280	9	Hatter's fur manufacturing
2288	6	Felting manufacturing
2305	6	Artificial silk manufacturing
2402	6	Carpet or rug manufacturing
2413	6	Textiles, bleaching, dyeing, etc.
2537	7	Hat manufacturing — other than straw or cloth — no hatter's fur manufacturing or blowing — starting or forming of felt hat shapes
2538	7	Hat manufacturing — other than straw or cloth — all operations
2586	8	Cleaning or dyeing
2600	9	Fur manufacturing
2623	9	Tanning
2660	9	Boot or shoe manufacturing or repairing
2731	14	Planing or moulding mills
2737	14	Sash, door or Assembled millwork manufacturing
2790	14	Pattern making — NOC
2791	14	Pipe manufacturing — wooden, tobacco
2794 Cal. Only	14	Wood turned products manufacturing
2802	14	Carpentry — shop only — excluding commercial lumber yards
2804	14	Coffin or casket manufacturing or assembling — wood
2812	14	Cabinet work — with power driven machinery
2815 Cal. Only	14	Cabinet works — boat building
2824	14	Tank, seat or cabinet manufacturing — wood
2841	14	Woodenware manufacturing — NOC
2870 Cal. Only	14	Billiard table manufacturing
2883	14	Furniture manufacturing — wood — NOC
2915	14	Veneer products manufacturing — veneer manufacturing
2916	14	Veneer products manufacturing — no veneer manufacturing
2920	14	Organ building
2923	14	Piano or player piano manufacturing
2960	25	Wood Preserving
3042	18	Elevator or escalator manufacturing
3064	17	Sign manufacturing — metal
3076	17	Fireproof equipment manufacturing
3081	17	Foundry — iron — NOC
3082	17	Foundry — steel casting
3085	17	Foundry — non ferrous metals
3086 Cal. & Wisc.	17	Foundry — malleable iron
3088 N. Y. Only	17	Railroad permanent ways material manufacturing
3089	17	Pipe manufacturing — cast iron — NOC
3091	17	Enameled iron ware manufacturing
3093	17	Pipe manufacturing — cast iron — by centrifugal casting
3112 Cal. Only	17	Tool manufacturing
3113	17	Tool manufacturing — NOC — not drop or machine forged
3114	17	Tool manufacturing — NOC — machining or finishing

CLASS NO.	SCHEDULE NO.	CLASSIFICATION
3117	17	File manufacturing
3122	17	Cutlery manufacturing — NOC
3126	17	Tool manufacturing — agricultural, construction, etc.
3146	17	Hardware manufacturing — NOC
3169	17	Stove manufacturing
3175	17	Radiator or heater manufacturing — cast iron
3183	18	Plumber's supplies manufacturing — NOC
3220	17	Can manufacturing
3223	17	Lamps or lantern manufacturing — NOC
3224	17	Agate or enamel ware manufacturing
3331	17	Lead works — sheet, pipe or shot
3336	17	Type foundry
3364	26	Welding or cutting — oxyacetylene
3372	17	Electro plating — NPD
3382	18	Clock manufacturing
3385	18	Watch manufacturing
3400	17	Metal goods manufacturing — NOC
3507	18	Agricultural machinery manufacturing
3515	18	Textile Machinery manufacturing
3548	18	Printing or bookbinding machinery manufacturing
3558	18	Boot or shoe machinery manufacturing
3559	18	Confectionery machinery manufacturing
3561	18	Sewing machine manufacturing
3574	18	Adding machine manufacturing — NOC
3583 Cal. Only	18	Automatic sprinkler manufacturing
3632	18	Machine shop — NOC
3634	18	Valve manufacturing
3635	18	Gear manufacturing or grinding — NPD
3638	18	Ball or roller bearing manufacturing — NPD
3642	17	Battery manufacturing — dry
3643	18	Electric power or transmission equipment manufacturing
3647	17	Battery manufacturing — storage
3683	18	Thermometer manufacturing
3805	18	Automobile or aircraft engine manufacturing
3807	17	Automobile radiator manufacturing
3808	20	Automobile manufacturing or assembling
3821	34	Automobile dismantling
3822	20	Automobile body manufacturing — pleasure car
3823	20	Automobile body manufacturing — truck body
3824	20	Automobile body manufacturing — NOC
3830	20	Aeroplane manufacturing
3831	20	Car manufacturing — railroad
3883	17	Car wheel manufacturing
4000	4	Sand or gravel digging
4021	22	Brick or clay products manufacturing — NOC
4024	22	Refractory products manufacturing
4034	21	Concrete products manufacturing
4049 Cal. Only	22	Pottery — manufacturing — glazed or porcelain earthenware

CLASS NO.	SCHEDULE NO.	CLASSIFICATION
4053	22	Pottery — china or tableware manufacturing
4054	22	Terra cotta manufacturing — for decorative purposes
4055 Cal. Only	22	Potteries — manufacturing
4058 Cal. Only	22	Potteries — manufacturing — electrical, porcelain ware
4061	22	Potteries — glazed or porcelain earthenware manufacturing — hand moulded or cast
4062	22	Pottery — manufacturing porcelain ware by means of mechanical press forming
4101	23	Glass manufacturing — polished plate
4102	23	Glass manufacturing — sheet window glass
4103 Cal. Only	23	Glass manufacturing — sheet glass manufacturing
4111	23	Glass ware manufacturing — no automatic blowing machines
4113	23	Glass manufacturing — cut
4114	23	Glass ware manufacturing — NOC
4206	12	Pulp manufacturing — ground wood process
4207	12	Pulp manufacturing — chemical process
4239	12	Paper manufacturing
4263	12	Fibre goods manufacturing
4299	12	Printing
4304	12	Newspaper publishing ..
4308	12	Linotype or hand composition
4351	12	Photo engraving
4352	12	Engraving
4400	10	Rubber reclaiming
4410	10	Rubber goods manufacturing — NOC
4417	10	Rubberboot or shoe manufacturing
4420	10	Rubber tire manufacturing
4431	10	Phonograph record manufacturing
4439	24	Lacquer or spirit varnish manufacturing
4440	24	Pyroxylin manufacturing — amberoid, celluloid, fibroid, etc.
4452	10	Pyroxylin or pyroxylin composition goods manufacturing
4456 Cal. Only	10	Leather manufacturing — imitation
4470	10	Cable insulation
4484	10	Composition goods manufacturing — plastic — NOC
4485 Cal. only	10	Horn, bone, ivory goods manufacturing
4492	10	Leather manufacturing — imitation
4536	24	Acid manufacturing — sulphuric only
4558	24	Paint manufacturing
4567	24	Lead manufacturing — red or white
4583	24	Fertilizer manufacturing
4596	24	Ink (writing), mucilage or paste manufacturing
4597	24	Polish or Dressing manufacturing
4653	24	Glue manufacturing
4665	24	Rendering works — NOC
4692	25	Dental laboratory
4703	5	Corn products manufacturing
4710	24	Candle Manufacturing — NPD
4720	24	Soap or soap powder manufacturing

CLASS No.	SCHEDULE NO.	CLASSIFICATION
4741	24	Asphalt or tar distilling or refining
4940	17	Soda water fountain or apparatus manufacturing
5469	36	Cleaning or renovating outside surfaces of buildings
5508	26	Street or road construction — rock excavation
5954	24	Whiting manufacturing
6251	26	Tunneling — not pneumatic
6252	26	Shafts Sinking — all work to completion
6254 N. Y. only	26	Subway construction
6257	26	Caisson work — pneumatic — not foundation
6258	26	Caisson works — pneumatic foundation
6260	26	Tunneling — pneumatic
7590	33	Garbage works — reduction or incineration
8205	5	Stock-yards — no butchering
9501	25	Painting — shop only
9505	25	Painting — automobile or carriage bodies
9600	25	Taxidermists

OCCUPATIONAL DISEASE HAZARDS

ANTHRAX

Anthrax is a contagious disease, common to man and most domestic animals, and transmitted by the skin or hides, hair, wool, or bristles of infected animals to man. With human beings, it appears in two forms: first, on the skin and, second, infrequently within the body. The disease is found in cattle, sheep, goats, horses, and pigs, especially those from foreign countries. It may occur in carpet mills, leather industries and tanneries, among brush makers, plasterers, felt makers, rag pickers, mattress makers, veterinarians, farmers, butchers, longshoremen, freight handlers, and occasionally in persons outside of any industry. It may also be found in connection with the preparation of skin in fur manufacturing.

The infection in the skin occurs, in a great many cases on the exposed parts of the body, such as the face, throat, neck, chest, hands, and forearms. The germ lodges in a cut or break in the skin and is rubbed in by the worker's dirty hands or the rubbing of clothing. It is particularly difficult and stubborn to correct and requires competent medical attention. The first step in the control of the infection is to use only hides, and skins from non-infected areas. Disinfection, by satisfactory methods, should be made of the hides and skins that have entered the country and are known to be from anthrax infected countries.

The usual course of an epidemic of anthrax, is that every year or so in the large leather tanning centers there are one or two cases which may be fatal. Immediately, after this there is considerable investigation and the greatest of medical precautions are taken for a short time. After a period in which the utmost precautions are observed, the scare dies down and the industry returns to its normal operations and no notice is taken until there is another outbreak. Due to the comparative rarity of anthrax it is difficult to maintain observance of all the safety precautions.

Some of the methods for the prevention of the infection from anthrax are as follows:

1. Remove all visible factory dust by means of mechanical exhaust at the point of origin.
2. Dispose of the dust collected by burning.
3. Make provision for a first aid kit with sterilized dressings, bandages, cotton, and a 2% solution of iodine.
4. Post a notice as to anthrax and its prevention.
5. Provide overalls for all workers exposed to the hazard.
6. Have lunch room separate from workroom.
7. Provide adequate washing facilities, hot water, soap, etc.
8. Have employees keep work clothes separate from street clothes.
9. Provide good, natural ventilation with sunlight wherever possible.
10. Instruct the workmen to prevent contact of hides with the bare skin.

ASBESTOSIS

A potential asbestosis hazard is to be looked for wherever asbestos dust is created. Among the possible sources are the mining and milling of asbestos, and the weaving, machining and the mixing of asbestos and asbestos compounds. Industries which have this exposure are insulation, brake lining and gasket manufacturing.

One of the most common operations where asbestos is used is in the manufacture of patch material for roofs. The practice is to dump the asbestos into a putty chaser with asphalt and the two materials are mixed together. There are a number of small plants that do this type of work without any particular attempt to control the dust.

While it is true that fewer workers are exposed to asbestosis than silicosis, it is a definitely important occupational disease hazard and should be considered as such. In the opinion of certain authorities it is established that asbestosis may cause disability and death, and that any well defined case of asbestosis is very likely to progress to a fatal conclusion. The pathology of asbestosis differs markedly from that of silicosis. The dust particles being larger, the damage is to the bronchioles rather than to the alveoli, the latter being too small to admit any large proportion of the particles. The fibrosis of asbestosis is characterized by the formation of so-called "Asbestos Bodies", a phenomenon quite different from any found in silicosis. The symptoms of asbestosis are generally similar to those of silicosis, particularly as regards a gradually increasing dypsnea (shortness of breath). Prolonged exposure to asbestos dust caused a pulmonary fibrosis of a type different from silicosis and demonstrable on X-ray films. Cases of definite heart enlargement are frequently found associated with asbestosis. A predisposition to tuberculosis does not appear to be caused by exposure to asbestos dust. It is not believed that asbestosis may add to the mortality of pneumonia, and acute non-tubercular pulmonary infections. The concentration of dust in asbestos fabricating plants depend primarily on the grade of asbestos: mill fiber gives rise to a higher concentration than crude fiber. Operation arranged in decreasing concentration of dust are preparing, carding, weaving, spinning, twisting and warping. The control is rather difficult but

CU 30017

it is important that all new employees be examined physically, including X-ray examination of the chest.

Inasmuch as exposure to this dust will cause enlargement of the heart it is also important that men with weak hearts should not be exposed to asbestos dust.

Some of the methods used to minimize the hazard from asbestosis are as follows:

1. Remove all visible factory dust by means of mechanical exhaust at the point of origin.
2. Improve the general plant ventilation by fans in the roof or sidewalls.
3. Physical examination of new employees and periodically for the older employees. This recommendation should be discussed with the Claim Department.

BENZOL

Benzol is a volatile, inflammable, almost colorless liquid with a strong sweetish smell. It evaporates very easily and makes a very good solvent for gum, resins and fats. Its vapors are heavier than air. It is also called benzene, but it must not be mistaken for benzine, which comes from petroleum and is much less harmful. Benzol comes from coal tar.

Benzol is used in industries in the manufacture of rubber cements, lacquers, varnishes and stains, paints and varnish removers, in the chemical industry, in cleaning of printers rollers, engraving plates, etc., in the manufacture of rubber goods, artificial leather, sanitary tin cans, oil cloth and linoleums. Also, at times it may be present in connection with the manufacture of airplanes, rubber reclaiming, phonograph record manufacturing, imitation leather and pyroxylin manufacturing, including such substances as viscoloid, fiberloid, and celluloid. It is used very extensively in the manufacture of dyes and is the starting point for a good many of the dyes and explosives. While much has been done to eliminate the use of benzol as a solvent or to control it in many industries, the use of benzol as a raw material in the manufacture of nitro-benzene, aniline and the other various dye intermediates will probably increase rather than decrease. There can be no substitute recommended for its use in connection with the manufacture of dye intermediates.

Poisoning usually occurs by the breathing of benzol fumes. When these are drawn into the lungs, benzol is dissolved in the blood and carried through the body. Acute poisoning occurs when large amounts are breathed in a short time. The nervous system is poisoned and the breathing apparatus paralyzed. Smaller amounts breathed over a period of time cause chronic poisoning which weakens and thins the blood. This type of poisoning is more common in industries. Benzol is also a skin irritant. It may be absorbed through the skin and the most common instance in industry is where the material is spilled on the clothes and no attempt is made to remove it.

The control of the benzol hazard depends upon the prevention of inhalation or skin absorption of the material. The following practices should be put in operation wherever possible:

1. *Don't use benzol.* This is often the simplest means of control. It is possible many times to find that another solvent may be used and the hazard completely eliminated. The dye and explosives industries are, of course, the exceptions to this general rule. Toluene is one material that might be used as a substitute. It is poisonous, but much less toxic than benzol. High boiling petroleum fractions also provide a non-inflammable, non-toxic substitute for benzol. In seeking to eliminate the hazard from benzol this recommendation should always be given careful consideration, and it will be found that in a majority of cases a suitable substitute can be found.
2. Remove benzol fumes at point of origin by exhaust ventilation.
3. Keep tight covers on receptacles containing benzol.
4. Do not allow articles treated with any compound containing benzol to dry in workrooms unless the vapors are removed.
5. Make drying chambers for materials treated with benzol mixture as gas tight as possible, and have the air pressure inside the chambers slightly less than that outside.
6. Spray objects with a paint mixture containing benzol only when they are in properly constructed and ventilated booths.
7. Inspect carefully pipe lines and other apparatus containing benzol to detect and prevent leaks.
8. Provide positive pressure helmets for workmen who repair leaks, enter benzol tanks or use any mixture containing benzol in a confined space.
9. Supply rubber gloves to workers in contact with liquid benzol.
10. In arranging exhaust ventilation remember that benzol fumes are heavier than air.
11. Test the concentration of benzol fumes in the air of work-rooms. Benzol should not be allowed to exceed one hundred parts per million of air.
12. Provide medical supervision for workers with benzol. This should be discussed with the Claim Department.
13. Transfer workers to other departments if benzol affects them.
14. Have a complete physical examination made of each employee, including a blood examination, before this employee works with benzol.

CU 30613

SAFETY IN THE USE OF BENZOL

Rapid strides are being made thru scientific research in protecting workmen from the toxic effects of chemicals used in industry. The extensive medical research on toxicity of Benzol, conducted by the United States Bureau of Mines, is an example. The application of a warning signal -- the urine sulfate test -- developed by this research, enables the employer to use a very desirable solvent and at the same time to avoid the possibility of chronic Benzol poisoning.

"The urine sulfate test is an alarm signal to the safety engineer. Low values on a group of workmen are an indication that additional ventilation is necessary. If the safety engineer uses the test and heeds the warnings, he need no longer fear the use of Benzol in his plant." (National Safety News, August, 1936.)

This circular describes the technique of this test, and outlines suggested methods of ventilation and precautions for the safe use of Benzol.

SPECIFICATIONS AND PROPERTIES OF BARRETT BENZOLS

GRADE	MAXIMUM RANGE °C	FIRST DROP (FIXED POINT) NOT BELOW	PERCENTAGE AT FIXED TEMPERATURE	DRY POINT (FIXED POINT) NOT ABOVE	SPECIFIC GRAVITY AT 15.5°C	ACID WASH NOT DARKER THAN	SULFUR COMPOUNDS AS H_2S OR SO_2	FLASH POINT APPROX. °F	SOLIDIFYING POINT
Thiophene Free	1	79.2°C	All within 1°C Incl. 80.2°C	81.2°C	.882 to .886	No. 2	None*	10-15	-
Nitration Pure	1	79.2°C	All within 1°C Incl. 80.2°C	81.2°C	.8820 to .8860	No. 2	None	10-15	Not below 4.55°C
Industrial Pure	2	78.2°C	All within 2°C Incl. 80.2°C	82.2°C	.875 to .886	No. 3	None	10-15	-
Industrial 90%	41.8	78.2°C	At least 90% shall distill at 100°C	120°C	.875 to .886	No. 6	None	10-15	-

All Grades are water white, pass Barrett copper corrosion test, and have zero acidity

* No trace of thiophene or carbon disulfide.

In order that an employer may follow the precautions described in this circular when using a material containing Benzol he should be advised of the Benzol content. The following label has been approved by the U. S. Public Health Service:

CAUTION - POISON
This product contains more than 15% Benzol † which is a
VOLATILE SOLVENT
USE WITH ADEQUATE VENTILATION
AVOID PROLONGED BREATHING OF VAPOR

† or at the manufacturer's option he may print the actual analysis of the fluid constituting the shipment.

URINE SULFATE TEST AS A MEASURE OF BENZOL EXPOSURE

CU 30019

Urine sulfate ratio is the amount of inorganic sulfates in the urine divided by the amount of total sulfates.

The urine sulfate ratio is a measure of the amount of Benzol vapors inhaled by the individual tested. It gives a definite warning signal of danger to exposure before the health of the individual is in any way affected.

The following table gives the indicated values for safe operation and the indicated precautions:

Urine Sulfate Ratios	Benzol Hazard	Precautions Indicated
Above 75%	No exposure	Normal range of sulfates
Below 50%	Unsafe	Additional ventilation is necessary
Below 25%	Dangerous	Stop exposure until ventilation is improved

The test has no diagnostic value, that is, it tells nothing about the health of the individual at the time the test is made, hence the test can be made by the factory chemist.

The urine specimen should be taken after the individual has been working three to four days. Do not make test on Monday if the employee is off on Sunday.

Take the specimen at the end of the working shift -- not at the beginning of the working shift.

METHOD OF ANALYSIS OF URINE SPECIMENS*

Inorganic Sulfates - Twenty-five cc. of urine, 100 cc. of water and 10 cc. of dilute hydrochloric acid (1 part concentrated HCl and 4 parts water by volume) are measured into a 200-250 cc. Erlenmeyer flask. If the urine is dilute ** 100 cc. of urine is taken and 4 cc. of concentrated HCl is added, 25 cc. of water may be added. Ten cc. of a 5 per cent barium chloride solution is added slowly, drop by drop. The urine solution should not be shaken, stirred, or otherwise disturbed while the barium chloride is being added. The solution is allowed to stand an hour or longer, according to convenience, then shaken up and filtered thru a Gooch crucible.† The precipitate is washed with about 250 cc. of cold water, dried, ignited and weighed.

Specimen for above test should be placed on ice immediately after voiding unless test is made at once. Barium chloride should be added within 24 hours.

Total Sulfates. Twenty-five cc. of urine and 20 cc. of dilute hydrochloric acid (1 to 4), or 100 cc. of dilute urine ** and 8 cc. of concentrated HCl, are boiled gently in an Erlenmeyer flask (200-250 cc.) for 20 to 30 minutes. The mouth of the flask should be covered with a small watch glass to retard loss of steam during the boiling. The flask is cooled in running water for 2-3 minutes and the contents diluted to about 150 cc. with cold water. To this cold solution 10 cc. of 5 per cent barium chloride is added and the procedure continued as described under "Inorganic Sulfates."

* Journal of Industrial Hygiene and Toxicology (Jan. 1936)

** A dilute specimen may be recognized by its weak color or by specific gravity test less than 1.005.

† No. 42 Whatman filter paper may be substituted for Gooch crucible.

BENZOL HEALTH HAZARDS

USE	HAZARD	VENTILATION	PRECAUTIONS	URINE SULFATE TEST
Closed system manufacturing processes.	No chronic hazard. Acute poisoning.	Unnecessary if there are no leaks.	Use air line mask when entering tank for cleaning or repairs. Workman should have safety rope and assistant on outside.	No value for acute poisoning
Mixers at room temperature.	Hazardous if used in closed room without floor exhaust.	Exhaust ventilation at floor very necessary.	Keep mixer covered. 50 C.F.M. exhaust inside mixer. See Fig. 1.	Use
Heated tanks & mixers.	Extremely hazardous if open or with loose cover.	Exhaust ventilation at floor near top of water cooled tube.	Make mixer air tight. Solid material may be added from floor above thru water cooled (60°F) double walled tube 12" to 24" diam. See Fig. 2.	Use
Dip lacquer, small parts.	Slight if enclosed and ventilated.	Enclose tank & basket while draining. 50 C.F.M. exhaust at bottom of enclosure. Also exhaust at floor level.	3" hole at top of enclosure. Rope thru hole to raise basket without opening door. See Fig. 3.	Use
Artificial leather & similar coating processes.	Severe hazard if ventilation is poor.	Room exhaust at floor near coating end important. Must have slight vacuum inside oven. (Min. 1/8" water suction.)	Make drying ovens air tight except for slots for fabric to enter and leave.	Very important
Spray coating	Slight if modern spray booth is used.	150 Ft. per min. air velocity into booth. Room exhaust at floor.	Increase air velocity in booth if urine sulfate test is under 50%.	Use
Industrial hand application.	Hazardous for continuous use without ventilation.	Room exhaust at floor. Down draft ventilation from work bench.	Increase ventilation if urine sulfate test is under 50%.	Use
Paint & varnish remover non-industrial (by painters).	Chronic poisoning hazard very slight if use is intermittent, not more than 1/2 day per week.	Door and window open at opposite sides of room.	Avoid use in small air tight rooms.	Not practical to use
Household use.	Very slight for occasional use.		Manufacturer should use Benzol label.	Not practical to use
Filling containers.	Slight if ventilation is good.	Exhaust ventilation at floor.	Remove air from container with slight vacuum & exhaust outdoors. See Fig. 4.	Use

URINE SULFATE TEST AS A MEASURE OF BENZOL EXPOSURE

Urine sulfate ratio is the amount of inorganic sulfates in the urine divided by the amount of total sulfates.

The urine sulfate ratio is a measure of the amount of Benzol vapors inhaled by the individual tested. It gives a definite warning signal of danger to exposure before the health of the individual is in any way affected.

The following table gives the indicated values for safe operation and the indicated precautions:

Urine Sulfate Ratios	Benzol Hazard	Precautions Indicated
Above 75%	No exposure	Normal range of sulfates
Below 50%	Unsafe	Additional ventilation is necessary
Below 25%	Dangerous	Stop exposure until ventilation is improved

The test has no diagnostic value, that is, it tells nothing about the health of the individual at the time the test is made, hence the test can be made by the factory chemist.

The urine specimen should be taken after the individual has been working three to four days. Do not make test on Monday if the employee is off on Sunday.

Take the specimen at the end of the working shift -- not at the beginning of the working shift.

METHOD OF ANALYSIS OF URINE SPECIMENS*

Inorganic Sulfates - Twenty-five cc. of urine, 100 cc. of water and 10 cc. of dilute hydrochloric acid (1 part concentrated HCl and 4 parts water by volume) are measured into a 200-250 cc. Erlenmeyer flask. If the urine is dilute ** 100 cc. of urine is taken and 4 cc. of concentrated HCl is added, 25 cc. of water may be added. Ten cc. of a 5 per cent barium chloride solution is added slowly, drop by drop. The urine solution should not be shaken, stirred, or otherwise disturbed while the barium chloride is being added. The solution is allowed to stand an hour or longer, according to convenience, then shaken up and filtered thru a Gooch crucible.† The precipitate is washed with about 250 cc. of cold water, dried, ignited and weighed.

Specimen for above test should be placed on ice immediately after voiding unless test is made at once. Barium chloride should be added within 24 hours.

Total Sulfates. Twenty-five cc. of urine and 20 cc. of dilute hydrochloric acid (1 to 4), or 100 cc. of dilute urine ** and 8 cc. of concentrated HCl, are boiled gently in an Erlenmeyer flask (200-250 cc.) for 20 to 30 minutes. The mouth of the flask should be covered with a small watch glass to retard loss of steam during the boiling. The flask is cooled in running water for 2-3 minutes and the contents diluted to about 150 cc. with cold water. To this cold solution 10 cc. of 5 per cent barium chloride is added and the procedure continued as described under "Inorganic Sulfates."

* Journal of Industrial Hygiene and Toxicology (Jan. 1938)

** A dilute specimen may be recognized by its weak color or by specific gravity test less than 1.015.

† No. 42 Whatman filter paper may be substituted for Gooch crucible.

15. Those who have any chronic disease or anemia should not do this kind of work.
16. Have a periodic blood examination at intervals of one to six months, depending on the severity of the exposure. It is possible at the present time to detect the onset of benzol poisoning by an analysis of the urine for sulphate. All of these recommendations which have to do with physical examinations should be discussed with the Claim Department.

CAISSON DISEASE OR BENDS

Caisson disease, or Bends, under which term this disease is most commonly known on construction work, is classed in most states as an occupational disease and is found on all jobs requiring the use of compressed air in the driving of tunnels or sinking of caissons. Divers in marine work are subject to this same disease. The disease is caused by work under a higher air pressure than atmospheric pressure, which is 15 lbs. per square inch. This increased pressure is necessary, in many cases, due to the fact that the tunnel or caisson is being put through soft ground, and additional pressure is necessary to keep back the water or possible cave-in.

Caisson disease is caused by the formation of nitrogen bubbles in the blood passages of the body and usually these nitrogen bubbles will come to rest in some joint of the body and cause extreme pain. Almost every state has a code which is very strict and requires close supervision of all workmen engaged in compressed air operations.

The disease can be caused by several conditions which arise from working under air pressure. First, the employee can remain too long a period under increased air pressure. Second, Lack of care on the part of the employee in entering or leaving the air lock of either the caisson or tunnel, as the case may be. There are state ordinances in most states prescribing the length of time an employee must take on entering or leaving air locks and returning to atmospheric pressure. This time is based entirely on the air pressure under which the men are working. A large number of workmen liking to show off to their fellow employees, rush in and rush out of the air locks when they can do so without taking sufficient time to allow their bodies to make adjustment to new conditions. They boast on how they can "take the air." The result is many of them are brought back to the medical locks to relieve them of the air bubbles in their blood system.

Another condition that may bring about this disease is the use of liquor. No employee working under compressed air should use liquor and each employee should take the best possible care of his body when engaged in this type of work.

Caisson disease or bends is first noticed by severe cramps and the only way to cure this is not by medicine, but to rush the patient back to the emergency lock and place him under air again. When he has reached the maximum air pressure, then he should be decompressed very gradually, and in most cases decompression will remove the difficulty and allow the blood to take care of these bubbles by passing them out of the system entirely. It is good practice, when coming out of the air pressure, while in the air lock, for an employee to stand up and walk about a little bit, if possible, in the lock chamber. This will allow any air bubbles that may be in his system to readily escape through his blood system.

Great care should be taken in picking out the man for the position of lock tender. He should be the type of man that the employees cannot dominate as to allowing them to run in and out of the air locks at any other rate of time than is prescribed under state laws for decompression. The lock tender should have strict orders and should be immediately discharged if he violates these orders to decompress workmen under air compression at any other speed than the standard rates of decompression, which is not faster than the following rate: from 0 to 10 lbs. gauge pressure, one minute, from 11 lbs. to 15 lbs., two minutes; from 16 lbs. to 20 lbs., five minutes; 21 lbs. to 25 lbs., twelve minutes; 26 to 30 lbs., fifteen minutes; 31 to 35 lbs., twenty minutes; 36 to 40 lbs. forty minutes; 41 to 50 lbs., fifty minutes; or roughly at the rate of a pound a minute. If these rules are strictly adhered to, we doubt if there would be many cases of bends reported on a job that would result in any lost time. Employees working under compressed air are only allowed to work a specific number of hours. This number of hours is governed by the air pressure being used and also the state in which the operations are being carried on.

Under no conditions should compressed air work be carried on unless there is a capable doctor on the premises who is familiar with this caisson disease. No men should be allowed to work under compressed air without passing a strict medical examination. Subsequent medical examinations should be made from time to time; in fact, this condition is governed in many states by the state laws as to just how often an employee should be examined. During the summer months, it is not compulsory in all states to provide a passageway leading from the lock chamber to the change house where the workmen change their clothes to protect these workmen from atmospheric conditions. During the colder months from November to April, a covered passage should always be provided to protect the employees coming out of the compressed air, as they are perspiring very freely due to this condition; the air is moist and stuffy, and they are subject to pneumonia in most cases on catching the least bit of a cold. In addition, a medical lock should always be provided for emergency purposes. This lock, of course, must be under the care of the doctor in charge of a trained nurse selected by such medical authority. Most states require a liberal supply of hot, black coffee to be kept on hand at all times if there are any men working under compressed air. Plenty of sugar should be provided for use if the employee desires it.

As a further precaution, many states require that all employees working under compressed air be required to wear an identification badge, giving their number, the job on which they are working, by whom they are employed, and usually there is a warning notice on the bottom of this badge to the effect that, if this employee is found unconscious or taken sick, not to take him to the hospital but to rush him immediately back to the job on which he is working at the address given on the badge. This saves valuable time in getting the employee back to where he can receive attention, as the average hospital is not provided or equipped to render treatment quickly on compressed air cases.

Careful check-ups of employees working under air should be made at all times. Some employees are more susceptible to the bends than others, due possibly to physical condition or their personal habits. Such employees should be eliminated from the payroll as compressed air workers.

CADMIUM

Cadmium is a metal which is coming into a much wider use than formerly. It is used in low melting alloys, photography, and for plating for protective surfaces.

Cadmium is sufficiently toxic to make it an industrial health hazard. The fume of cadmium oxide from molten cadmium induces edema of the lungs which results in death of experimental animals. In smaller amounts it produces generalized pneumonia and broncho-pneumonia. In very small amounts, cadmium produces scars in the lungs, though there are no subjective symptoms following such exposures. There is a change in the liver and kidneys due to exposure to cadmium. An exposure to 10 mg/cm3 for twenty-four hours is enough to cause very serious symptoms. For a short exposure to a high concentration it is much more toxic than lead.

The greatest health hazards are found in the manufacture of cadmium and in the handling of its compounds. The following list shows where the most haxardous exposures have been encountered.

1. Vapor or fume from the retorts or condensors of the blue powder furnaces, in making both cadmium and cadmium oxide.
2. Fume from and near the collecting bags in making cadmium oxide. The particles which constitute this fume are so small that they are not caught in the bags.
3. Dust in handling cadmium oxide, as such, especially working up the residues from this process.
4. Manufacturing and handling cadmium lithopone and working up the residues from this process.
5. Manufacture and handling of cadmium sulphide.
6. Spraying cadmium sulphide (as a paint).
7. Welding alloys containing cadmium or cadmium coated articles.
8. Melting metallic cadmium or its compounds without adequate ventilation.
9. Handling any cadmium compounds which may be inhaled or ingested.
10. Using cadmium coated or plated articles for any purpose where they may come in contact with food or drink.

Cadmium coatings are applied by electroplating and consist in general, of cadmium carbonate dissolved in a solution of sodium cyanide and some substance, usually protein (milk, cheese, casein, wood shellac, glucose or licorice) which favors a more uniform deposition of cadmium on the articles.

Cadmium lithopones are formed by precipitating cadmium sulphate with barium sulphide. The cadmium yellows mixed with ultramarine blues give brilliant and very stable greens.

Essentially the same precautions should be observed as with lead exposure: such as good ventilation, personal cleanliness, avoid heating of cadmium except in exhausted hoods, use of approved respirators on dusty jobs with cadmium.

Particular attention should be paid to foundries. Certain small brass foundries melt cadmium. This should be done with good ventilation and at a low temperature. Cadmium melts at 321.6 C and boils at 773.9 C and so it obviously cannot be heated in the same manner as brass which melts at 1050 C. It should never be poured when it is giving off brown fumes. It is advisable to wear approved respirators while pouring cadmium although the precautions of ventilation must be also observed.

The spraying of cadmium sulphide as a paint should be checked. In plants where one is informed that the paint is not a lead base one should always find out if possible what is used.

The other main hazard is the handling of cadmium salts in such a manner as to cause dust exposure. The manufacture of paint is likely to lead to exposure of this type. Adequate ventilation and respirators of an approved type should be used.

MATERIALS HANDLED IN BRASS FOUNDRIES IN ORDER OF INDUSTRIAL HEALTH HAZARD

LOW	(1) Bronze	90% Copper	10% Tin
	(2) Red Brass	85% Copper	15% Zinc
	(3) Admiralty Metal	70% Copper	29% Zinc 1% Tin
	(4) Yellow Brass	67% Copper	33% Zinc
	(5) Muntz Metal	60% Copper	40% Zinc
	(6) Phospor Bronze	79.7% Copper .8% Phosphorous	10% Tin 9.5% Antimony
	(7) Bearing Metal	83% Copper	14% Tin 3% Lead
	(8) Metallic Zinc		
HIGH	(9) Metallic Lead		
	(10) Metallic Cadmium		

In inspection of brass foundries the composition of the alloy which is poured should be determined if possible. If lead, cadmium or antimony are used, all grinding wheels should be exhausted.

If cadmium, lead or zinc are melted alone there should be a strong exhaust ventilation to remove fumes.

CHROME

Chromic acid and its compounds are the substances which produce the trouble in this classification. Chromic acid is a red solution made by adding water to a compound of chromium and oxygen that is called chromium trioxide. Chromic acid and its salts of potassium, sodium, and ammonium are strong irritants.

Chromic acid or its compounds are used in electro-plating, lithography, photography, photo-engraving, leather tanning, blue-print making, textile printing, fur and cloth dyeing, pigments, and the manufacture of colored crayons. Also, it may be used in connection with lamp or lantern manufacturing, automobile parts manufacturing, and manufacture of office equipment.

The poisoning occurs from the irritating action of any chrome solution or dust on the skin and by inhaling chrome vapors or dust. Irritations and ulceration of the skin, commonly called "Chrome Holes," are the most persistent of any of the industrial skin conditions and the most difficult to cure. *Since the control of the chrome hazard depends* on ventilation and reducing contact with the skin as far as possible, the following requirements should be carefully followed:

1. Have good general ventilation of work-room.
2. Remove chrome dust and vapors at point of origin by special exhaust ventilation.
3. Do not allow chromium solution to drip upon the floor.
4. Provide hot water and soap for washing.
5. Keep street clothing separate from work clothes.
6. Keep lunch-room separate from work-rooms and locker-rooms.
7. Inspect the hands of all workmen daily.
8. A protective ointment, such as lanolin and petrolatum, which can be rubbed into the hands and applied to the nose before work in the morning and after lunch, should be supplied.
9. Have a complete physical examination made of all employees before working with chrome.
10. Wash chrome solution off hands frequently.
11. Have a regular physical examination at lease once a year.

LEAD

Lead is a heavy, soft, bluish grey metal. It is used in industry in both the metallic form and in compound, the commonest compound being white lead or lead carbonate, followed by the oxides which are formed by the combination of lead and oxygen on heating metallic lead. The most important are red lead and litharge: heavy, red and buff colored powders respectively. Compounds with carbon, sulphur, and chrome (lead carbonate, lead sulphate, and lead chromates) are also freely used in industry.

There are about 150 industries with some exposure to lead. It is present in pigments, putty, paints, glazes, polishing powders, and solder. The chief hazardous lead industries are lead compounds, storage batteries, pottery, painting, printing, plumbing, lead smelting, and lead refining. It will also, on occasions, be used in connection with all or some of the following occupations: tree pruning, repairing, and fumigating; plumbers' supplies and in the manufacture of enamels, ironware manufacturing, hardware manufacturing, radiator manufacturing, acetylene welding and cutting, automatic sprinkler manufacturing, linotype or hand composition, and dry grinding, blending and testing of colors. Lead poisoning occurs most easily from the inhalation of lead fumes and dust; next from getting lead compounds in the mouth and lastly from the skin when it is broken. Tetraethyl lead can be absorbed through unbroken skin. Lead taken into the system at first circulates in the blood and may damage any organ of the body.

The following suggestions are helpful in preventing lead poisoning:

1. Have good general ventilation of work room.
2. Remove dust and fumes at points of origin by special exhaust ventilation.

3. Do not allow dust to collect in work rooms.
4. Have floors of cement or other impermeable material to permit thorough cleaning. Cleaning in extremely dusty places should be done after working hours and with the use of water or a vacuum cleaner.
5. Keep covers on receptacles containing lead compounds in powder form. These should be of metal to prevent breakage and spilling.
6. Furnish overalls and gloves to all lead workers and masks when necessary.

From the standpoint of employees, the following are good suggestions to have in mind.

1. Wash hands and face before entering lunch room.
2. Take frequent shower baths when exposed to lead dust.
3. Keep street and factory clothes separate.
4. Do not smoke, or chew in work rooms.
5. Avoid constipation and drink milk freely.
6. Have a physical examination, including an examination of the blood before working with lead.
7. Have a regular examination of the blood for stippling at least every three months.
8. Those who have any chronic disease or anemia should not do this work.
9. Workers having had lead poisoning should not return to a lead trade.

MERCURY

Mercury is a heavy, silvery, liquid metal which gives off a slight vapor at ordinary temperatures. It is used in the treatment of gold or silver yielding metals, manufacture of scientific instruments, alloys with tin and copper, in lead-mercury solder, amalgamation of zinc for accumulators and electrodes, dental amalgams preparation of explosives, preparation of hatters' furs, manufacture of mercury pumps, mercury boilers, and mercury arc rectifiers.

Industrial mercury poisoning almost always occurs from breathing mercury vapor over a long period of time. Mercury can also be absorbed into the system through the skin. Methods used for the control of the mercury hazard are as follows:

1. Have good general ventilation of work room.
2. Remove mercury vapor and dust at the point of origin by special local exhaust ventilation.
3. See that floors and workrooms are of cement or other non-absorbing material. This is especially important because mercury vapor will be given off from floors which have collected mercury dust.
4. Have floors washed every night with water containing ammonia to neutralize the effect of mercury vapor.
5. Provide gloves and masks when necessary to exposed workers.
6. Keep street clothing separate from factory clothing.
7. Have lunch room separate from work rooms and locker rooms.
8. Rotate workers exposed to mercury to other work at intervals.
9. Provide proper washing facilities and encourage frequent washing.
10. Provide medical supervision for exposed workers.
11. Have a complete physical examination of each worker made before working with mercury and have regular physical examinations made at least once a year of all employees exposed to mercury.

DERMATITIS

The number of cases of skin irritations which are resulting in claims is rapidly increasing. At the present time government statistics show that about 65% of industrial diseases are dermatoses. Although, the individual cost of many of these cases is very small, it has been found due to the large number of cases that the cost is too large to be ignored.

It so happens that there are several causes for the various skin irritations and for the purposes of discussion, they will be classified according to the type of agent which causes the trouble.

Irritants may be grouped as follows:

(1) Mechanical or physical agents, such as abrasions, heat, cold, actinic ray, friction.
(2) Flowering plants and their products — resins, lacquers, wood dust.
(3) Vital agencies:
   (a) Bacteria, yeast, molds.
   (b) Members of the animal kingdom — mites, etc.
(4) Chemical agents:
   (a) Inorganic compounds — acids, bases, salts.
   (b) Hydrocarbons and crude coal tar products—oils, tar, pitch, etc.
   (c) Other organic compounds.

MECHANICAL OR PHYSICAL AGENTS

There have been cases of dermatitis caused by men standing for several hours with their feet in icy water. Among certain individuals there have been cases reported where the man has skin eruption caused by exposure to the heat of rolling mills. Exposure to X-ray or radium will produce atrophy of the skin, superficial inflammation and a tendency towards ulcers. This refers only to small ulcers which do not produce any immediate effect as acute exposure to these materials will of course, produce very serious systematic effect. In the particular place we are merely concerned with the effect on the skin. Mechanical abrasions due to soaps are frequent. The eruptions of plasterers and paperers are dependent on mechanical irritation of the surface of the skin. Of special importance are the skin diseases caused by lubricants. These rashes are generally speaking of two kinds—the first is due to the plugging of the small gland at the roots of the hairs on the arms and legs of the workers. The second due to mechanical injury to the skin produced by mechanical particles suspended in the cutting lubricants. This particular type of dermatitis which is the most common and the most likely encountered by the engineer and also the one which he can do the most to prevent.

It may be controlled in the following manner. Cleanliness of the worker should be insisted upon. Washing accommodations for the workers in contact with oil must be on a liberal scale. Hot water, soap, and scrubbing brushes are essential. Constant removal of metal particles from the oil by filtration is necessary to avoid irritation to the skin. The use of protective soap or hand creams for exposure to the oil or grease will do much to eliminate oil acne or oil boils.

FLOWERING PLANTS AND THEIR PRODUCTS

The important woods productive of dermatitis include red wood, teak, cocobolo, oak. Extracts and resins such as cashew, vanilla, resin dusts and lacquers. The following plants also have caused trouble, such as asparagus, barley and malt, celery, chomomile, flax, hops, grain dust, pyrethrum, rice, tobacco, tulip, primrose, and jonquil. In connection with some of these irritations, particularly the case of woods, it is sometimes necessary to change the occupation. Teak wood is a decided irritant to the skin in the form of dust. In the case of chestnut, there is found a marked thickening of the skin of the hands and systematic effects such as headaches may appear from the absorption of the essential oil.

In the case of the extracts and resins, cashew nuts contain an irritant oil, called cardiol. This oil is used to color or preserve vanilla pods and thus is the source of irritations due to vanilla. It is, also, used for a laundry marking ink, while the nuts are used as substitutes for almonds and other nuts. The oil from cashew is taken up by the system, and will cause toxic effects and headaches. This accounts for some of the trouble encountered by laundry workers. Operators handling this material should rub their hands with vasoline before handling the product, wear suitable gloves during the operations and wash carefully afterwards.

Lacquers are frequently the cause of dermatitis. The varnish from certain lacquer trees is very similar in effect to the poison sumac and poison ivy. In certain lacquers from Burma and Indo-China, the poisonous ingredients have been found to be harmful after one thousand years. There has been a case of dermatitis reported by a seller of toy canes from the handling of the lacquer on the canes. In the case of exposure to the various plants, the prevention is a matter of personal cleanliness and avoiding of exposure. This may be done by the use of gloves and protective creams.

In connection with the vital agencies, such as skin irritations caused by bacteria, the following information will give an idea of where trouble may be anticipated:

Medical literature reveals common occurrence among ice cream handlers, beet sugar workers, butchers, lathe operators, bakers, oil workers, machinists, soap makers, tallow refiners, cold storage workers, fertilizer makers, tar workers and street sweepers. In ice cream workers, in whom the skin is exposed to rock salt and water, salt infection is said to be due to feeding the hair follicles with organisms normally on the body and in outside dirt that comes in contact with the skin. In beet sugar workers, sugar boils are caused by sugar dust and perspiration forming a culture suitable for the growth of these organisms on the body surface. In lathe operators, it is said to be due to an infection of the minute wounds made by small pieces of metal that pierce the skin in the course of the work, or to the sealing up of organisms in the hair follicles by oil which comes in contact with the skin, or to organisms being deposited there by the oil. In cold storage workers, it is probably due to lowered body resistance due to sudden and frequent changes in temperature. In other occupations it is, also, a natural outcome of the work in which organisms normally found on the skin get a foothold as the result of the conditions under which the work is done.

Erysipeloid may be caused by the handling of meat and fish, crab bites, scratches from fish bones and butchering of pork. Within twenty-four hours a characteristic purplish-blue redness, with swelling, extends over the injured finger and the rest of the hand. The lymph glands usually enlarge and become tender. The attack may last from two to six weeks.

In connection with dermatitis caused by small insects there have been cases of rash appearing on the forearm, backs, hands and faces of men engaged in shoveling dry figs. On examination of the sores, a parasite was discovered and identified. Similar cases occurred in men engaged in loading sacks of peas from Morocco. In connection with this, cases have been reported from food mites, sugar mites, harvest mites and from the red spiders which infest loads of guano. There have been also cases reported from the handling of fowl which might be due to a mite appearing on the bird.

Probably the most common cause of dermatitis are the chemical agents.

Acids produce either burns or, in larger amounts, ulcers. The action of the acids such as hydrochloric, nitric and sulphuric are more likely to be in the nature of burns of accidents rather than in the nature of a slow-developing dermatitis. In the case of the bases, the alkalies enter the skin in several ways. In weak solution they emulsify the skin fats and render the skin less resistant to the attack of other substances. The strong alkalies include lye, potash and lime. These materials dry the skin and act as solvents as well. Thus the fingernails become cracked when the hand is dipped in such solution. These lesions appear in plasterers, cement makers, brick layers, masons, stone cutters, brick makers, modellers and in some metal platers. The most common occurrence of this is the cement workers' dermatitis. A rash appears on that part of the body exposed to cement dust or on the feet if the worker wades in soft cement in leaky shoes. A chronic lesion is the more common type.

Cyanide is a skin irritant, but its action is enhanced by the presence of lime. Arsenic, chlorine, cobalt, magnesium and nickle may cause trouble.

Chromium, as chromic acid or as a bi-chromate is a strong oxidizing agent and a frequent cause of skin lesions. It is noted most often in chromium plating, chrome canning and lithographing industries. It is also observed in makers of chrome dies, painters and dyers. There have been cases reported for dermatitis in susceptible persons working on blueprints. A prevention of this hazard, it is necessary in the case of chrome plating to ventilate the tank by drawing air horizontally across the top of the tank. So far as possible rubber gloves, aprons and shoes should be worn. Frequent applications of vasoline, mentholatum salve to the nose and hands greatly reduces the danger of ulceration. Many of the standard protective creams for this use will greatly minimize the hazard.

In considering this matter of dermatitis, it appears that almost every substance may cause a dermatitis among the persons who are susceptible. The material that may cause the trouble may be different for different persons, but in cases where it is observed the only precaution is to prevent contact. The use of rubber gloves, protective creams and a great deal of care to personal cleanliness is the best method of prevention. We would, also, urge the use of protective creams on any of the jobs which are known to be causes of skin irritations. Too much insistence cannot be placed on proper washing facilities which would mean an adequate supply of hot water, with soap and towels. In some cases, the conditions may be aggravated by the wearing of dirty working clothes for a considerable period of time. On jobs where there has been trouble from dermatitis, it should be insisted that the men wash up and change their clothes before eating and before leaving the plant. There should be a clean locker space for the men to store their street clothes in during working hours. The working clothes should be cleansed as often as necessary to prevent contamination of the skin from the soiled or oil-soaked working clothes.

A number of materials are skin irritants. Certain textile dyes, rubber accelerators and hair dyes are definite skin irritants. We are giving a list of some of these materials which have caused trouble. This list is not complete, but we expect to obtain more information from the engineers' reports. In any case, where skin irritation is reported from dyes, the engineer should try to find out what the dye is that caused the trouble.

IRRITANT DYES

Sudan IV
Bismark Brown
Napthol Yellow
Amido-Azo Benzene
Dimethyl-Amido-Azobenzene
Picric Acid
Malachite Green
Methyl Violet
Metanil Yellow
Diphenyl Black Bare
Orange II
Martins Yellow
Fuchsin Acid
Spirit Blue
Water Blue
Eosin
Erythiosin
Phloxin
Safranin
Acridine Red
Chysoidine
Aurantic
Para-nitraniline Red
Resorcin Green
Victoria Red
Sulphur Black
Soluble Acid Azo Dyes

NOT IRRITATING

Vat dyes
Indanthrene dyes
Logwood
Cutch
Fustic
Hair Dyes

MOST IRRITANT

Toluene diamine
p Amino diphenylamine
p Amino dimethylaniline
Diamido phenols and their Sulphonic acids
Nitro diamino compounds
Chlorodiamines
Henna, if mixed with diamines or pyrogallol
Amino anisole or phenetoles
Amino phenyl napthylamines
Chloroamino phenols

DYED FURS

p Phenylene diamine
Dimethyl p phenylene diamine
Amino phenols
Azo dyes

IRRITANT RUBBER ACCELERATORS

Highly Irritant
Aniline
Hexamethylene tetramine
o & p toluidine
p Nitroso dimethylaniline
m & p phenylene diamine
m & p toluene diamine

MODERATE TOXICITY

a napthylamine
Aldehyde ammonia
methyl aniline
B napthol
Methylene dianilide
Diethyl dithio carbamate
Methyl p phenylene diamine

LOW TOXICITY

Di-o-tolyl ethylene diamine
Di-o-tolyl urea
Diphenyl thiourea
Phenyl ethylene diamine
Xanthate
Guanadines
Mercapto benzothiazol
Piperidine derivatives

MISCELLANEOUS IRRITANTS

Chrome
Formaldehyde
Chlorinated Hydrocarbons
Gasoline
Bakelite
Phenol-Formaldehyde Resins
Benzol
Mercury salts
Strong acids or acid anhydrides
Strong calcium chloride
Nitric acids
Perchloric acid
Chromic acid
Strong metallic salts
Tannin solution

PHOSPHORUS

There have been cases of phosphorus poisoning reported in the use of white phosphorus used in the manufacture of matches, incendiary forms for military use, fireworks phosphor-bronze and fertilizer. The old Lucifer, strike-anywhere match was made from white phosphorus and it was in the use of this that poisoning occurred. The red phosphorus used in making safety matches and the phosphorus sesquisulphide which is now used for strike-anywhere matches are not poisonous. Some of the bad cases of phosphorus poisoning have occurred in match making and fireworks manufacture, and at the present time there is little exposure in these two fields because of the hazards involved. The use of white phosphorus for military use will probably increase, but this exposure is limited to a few firms and there is not much that can be done in the way of providing substitutes in the particular field. During the World War there were no records of any cases of phossy jaw in the manufacture of incendiary bombs in the United States, and there were only two cases reported in France. There are two exposures which should be considered from an industrial standpoint in connection with this material. One is the use of phosphorus in rat poison and the other is in the use of a fertilizer and a by-product in the manufacture of fertilizer.

In the manufacture of rat poisoning it is the practice to take the white phosphorus and mix it up with lard and flour in the form of a paste which is then bottled or tubed and prepared for shipment. The exposure here is in the mixing and handling of the material. The control in this case is of course by means of adequate ventilation at the mixers and near the packaging machine. In classes of this type the manufacturer or the ownership provides free medical and dental care for the employees. Because of the fact that the phosphorus poisoning starts through a decayed tooth, it is necessary that teeth of all workers in the phosphorus trade should be inspected at very frequent intervals. It should be mentioned, however, that in the manufacture of rat paste, probably because of the intermittent character of the work, no serious case of phosphorus necrosis has ever been found.

At the present time in connection with the new developments in the fertilizer considerable white phosphorus is being made from crushed phosphate rock. It consists of mixing crushed phosphate rock, coke and sand in electric furnaces which are heated to a high temperature. The phosphorus passes off the top into a water condenser where it becomes solid in form. The phosphorus is transferred under water to a steam jacketed kettle where it is melted and then syphoned into another jacketed kettle, filtered through heavy canvas, syphoned into another tank from which it is dipped and poured into molds. Since the phosphorus is heavier than water it sinks to the bottom of the tube and the water stands on top. The details of the operation may vary considerably from plant to plant, but it is obvious that there is a possibility of considerable exposure in this particular type of industry.

In connection with this material and properties of the different kinds of phosphorus are of interest because of the fact that the white phosphorus, which becomes yellow when exposed to light is very poisonous and the red phosphorus (obtained by heating the white) to about 238 C. in a closed vessel is a non-poisonous when pure.

White phosphorus has the appearance of a somewhat transparent white wax, is soft and can be cut with a knife. It melts at 44 C. and boils at 287 C. When exposed to the light it becomes brownish yellow. White phosphorus oxidizes rapidly, catches as fire, spontaneously in the air with a formation of white fumes. It is luminous in the dark. White phosphorus is a powerful poison and 1/10 of a gram is sufficient to cause death. In cases of phosphorus poisoning it is found absorbed in the liver (which is distended) in the blood, and in the expired air. The antidotes consist of one gram of copper sulphates, dissolved in a half a liter of water.

Red phosphorus consists of an apparently amorphous white reddish brown powder without odor and is not phosphorescent in the dark and is not set on fire by friction. It is not poisonous, and catches fire only at a temperature above 260 C. When heated rapidly to 260 C. in an atmosphere of carbon dioxide it is transformed into the vapors of ordinary yellow phosphorous.

As an industrial poison it occurs only in the chronic form, occasioned by the absorption of very minute particles of the white phosphorus long after the worker has left the exposure. Chronic phosphorus poisoning affects the bones of the face, beginning with inflammation and sclerosis of the bones. Swellings and ulcerations on the gums and the mucous membranes, pain even in the sound teeth, loosening and falling out of the teeth, destruction of the jaw bones and numerous channels which burrow through the cheek. The under jawbone is more often affected than the upper: here the process goes on without formation of new bones but with local destruction of the parts. There is a remarkable brittleness of the bone, decline of appetite, complexion, diarrhea, emaciation, but in spite of all these symptoms it is very rare that death occurs from exposure to this material until considerable time has elapsed. Because of the horrible symptoms it is necessary to avoid exposure to this material wherever possible. There is no specific medical treatment and all of the work possible should be done in the way of prevention of exposure. In any cases where the engineer suspects there is exposure to light phosphorus full details should be reported to the Home Office. Particular attention should be paid to whether or not dental care is furnished the workers. Isolation of the process and ventilation by means of exhaust hoods, and general ventilation will minimize, but not eliminate the hazard.

ROCK WOOL

The utilization of furnace slag in the form of wool for insulation purposes has become so extensive that the former metallurgical by-produce is now manufactured direct and marketed under various names such as rock wool, mineral wool, etc. In insulating houses, this material is blown into all spaces in the outer walls and a covering laid down in the attic so that the house is completely insulated. There is considerable dust exposure in the blowing of the insulating material into the walls. Tests indicate that even excessive concentrations of glass wool do not produce fibrous reaction when injected into animals. Animals that have been exposed to the dust of the rock wool do not show any significant physical changes. It is our opinion that exposure to rock wool dust does not constitute a serious occupational disease hazard: however, it is to be desired that when men are exposed to high concentrations of this dust that respirators be worn. This is because in case of claims it is very possible that people might bring out the fact they have been exposed to excessive amounts of this dust which contain little, if any, free silica and that no protection had been provided.

ANNEALING

Malleable cast iron is made by the annealing of white cast iron within a certain range of composition. There are two distinct forms, the black heart and white heart. In the manufacture of white heart malleable cast iron, the white cast iron is packed in iron oxide (mill scale or hematite ore) for several days at a temperature of 900 to 950 degrees Centigrade. The decomposition of the cementite is followed by the removal of most of the carbon. There is no particular hazard connected with the operation.

In the manufacture of black heart malleable iron the packing material is an inert material such as sand or cinders. The inert material is used so that none of the carbon will be removed except that on the surface. When sand is used as the packing material there is considerable hazard connected with its use. The sand is dry, and in dumping the annealing pots there is a large amount of dust.

If sand is used as a packing material in an annealing operation, the pots should be dumped under a hood. If this is not feasible, the castings should be handled in an isolated room by men wearing respirators. Whenever an engineer inspects a foundry where any annealing is carried on he should describe in detail the nature of the packing that is used and the manner in which it is handled.

WELDING

Welders are exposed to electric shocks and burns, radiant energy, gases, fumes and dust. Although the question of shocks and burns is not one which involves occupational disease exposure, it might be well to mention, in passing, some of the precautions that can be taken. The operator should be careful to shut the current off while changing electrodes. It is dangerous to remove them while they are alive unless the operator is insulated from the ground or wears insulating gloves. Welders should always stand on dry footing. In case of electric shock, artificial respiration should be given at once. For protection from possible burns from globules, the operator should wear a protective apron. Some operators also wear leggings and sleevelets of leather or other fire-resisting material. A gauntlet type of glove, preferably of leather, is sometimes used for protection of the hand from the arc rays and splatter of molten metal and sparks. The protection against radiant energy is well recognized. It is important for the assured to realize that the glass shields in the welders' helmets should be of such composition to absorb the infra red and ultra violet rays. It is not a question of just a piece of colored glass, and care should be exercised in purchasing protective equipment to make certain it meets with standard specifications. One point that is often overlooked is that welders' helpers, crane operators and others in the shop should be supplied with suitable welders' goggles.

Under the occupational disease hazards connected with welding we have (1) gases, (2) fumes and dust. Under the first heading of gases there is a considerable difference of opinion regarding the exposure. There is no question that oxides of nitrogen, ozone, may be formed during arc welding. There have been some death cases reported with symptoms similar to those caused by nitrogen peroxide poisoning, where the men were engaged in arc welding. However, these cases are very rare and it is possible that there is a question of individual susceptibility. It has never been proved that dangerous concentrations of nitrogen oxides or ozone can be generated by the welding arc. It is almost certain that it is not possible to generate any appreciable amount of nitrogen oxides or ozones from the acetylene welding flame.

The situation at the present time in regard to gas poisoning from welding operations seems to be that there is an irritating gas of some sort given off in welding which may cause fatal lung irritations among certain individuals working in confined spaces. We have found marked cases of oxygen deficiency among welders working in rather poorly ventilated buildings. The buildings were not small enough so as to be called a confined space, and for this reason a great deal of ventilation is necessary in connection with welding operations.

2. *Fume Hazard*

By fume hazard we refer to the fine metallic or mineral oxide volatilized by heat. These fumes may come from the materials welded, from the coatings of the materials welded and from the coatings of the electrodes. The most serious hazard that may be encountered is that of lead poisoning. The symptoms are colic, constipation, wrist drop, loss of appetite, nervousness and even insanity. The most serious cases of lead poisoning from welding have occurred among men cutting metal that had been painted with lead paint. Manganese is a possible source of poisoning from the welding rod coatings. In the gas-shielded type of electrode coating there is considerable manganese which may be volatilized. Among the more common types of electrode coatings this is the only caustic metal that might be given off.

In the welding of galvanized material, zinc oxide fumes are given off which cause zinc chills, ague or metal-fume fever. This is very uncomfortable and sometimes briefly disabling, but not considered dangerous and does not have detectable after effects.

In connection with welding in confined spaces, it has been found that these men show x-ray plates which are very similar to those of silicosis. At the present time it is considered that this condition is not silicosis, because the men are apparently in good health and show no predisposition to tuberculosis. However, because of this condition, it is well that welders are not exposed to silicosis producing dust. For this reason, arc welding should not be done in the open foundry or in other dusty locations. From a claim standpoint, it would make the man's condition appear much worse if he had a slight indication of silicosis, the welding exposure would make the x-ray plates much worse than the condition really was. It is believed at the present time that the x-ray findings in welders are probably due to a harmless coloration of the lungs from iron oxide.

Proper control of the hazards from welding is based upon the following precautions: (1) Ventilation.

In all shops there should be ample ventilation. Even in comparatively large shops cases of oxygen deficiency have been found. In confined spaces ventilation is absolutely necessary. In most cases it will be found cheaper and easier to use exhaust hoods placed as near the work as possible for the best results. It is much simpler to remove the fumes from the air at the point of generation than to change the air in a large room often enough to keep the concentration within safe limits.

2. For galvanized work in well ventilated shops, an efficient filter-type respirator will prevent zinc shakes or ague.

3. The use of air masks will give complete protection from dust, fumes and oxygen deficiency.

4. Any man with a chest cold should be very adequately protected while welding. If he has to do any galvanized work he should wear an air mask.

5. For work in a rather poorly ventilated shop where there is no danger of oxygen deficiency, a combination filter-type and chemical-type respirator will give satisfactory protection.

6. The welder should have some idea of what he is working with so he may plan his ventilation and protection accordingly. He should know whether or not the material he is cutting is painted with lead paint or not. It is obvious that if he is working with a gas-shielded type of electrode more ventilation is necessary than with the slag-shield type.

7. In stainless steel welding using a rod with a calcium fluoride flux, there are very obnoxious fumes given off and the local exhaust hood or air mask should be used for protection.

8. In case a man is overcome he should be kept absolutely quiet. Unless breathing has stopped, artificial respiration should not be given. This is liable to favor the formation of water in the lung. A doctor should be called at once and the patient should not be allowed to sit up, although he may appear to be recovered. In case of poisoning from irritating gases such as the oxides of nitrogen, the pulmonary congestion may set in from six to twenty-four hours after exposure. In connection with the precautions, we would like to bring out that in most cases there is not an outstanding hazard connected with welding operations, but under certain conditions there may be a very dangerous condition. The main recommendation to make is the providing of an adequate amount of air to the workmen, either by exhaust ventilation or air masks.

SILICOSIS

There are three known factors upon which the development of silicosis depends:

1. The amount of free silica in the dust.
2. The concentration of dust in a state of fine division in the air breathed.
3. The duration of exposure to such a dust.

The question naturally arises as to what is silica. Silica is the oxide of the mineral element, silicon, which is a constituent of more than half the rocks and minerals that form the earth's crust. It is important, in view of what is known about the disease, silicosis, to distinguish between silica in the free state and silica in the chemical combination with soda, lime, magnesia, metal oxides and other basis. These compounds of silica are known as silicates.

Free silica in the crystalline form is practically synonymous with quartz, but it also occurs as tridymite and cristobalite. Quartz in its commonest natural forms, occurs as sand, sandstone, quartzite and rock quartz. Quartz is also a large component of schist, flint, chert, granite, tripoli sand and rotten stone. It occurs in certain precious gem stones and in pegmatite dykes usually found in feldspar rock.

Tridymite and cristobalite are not abundant in nature, but are found in artificially manufactured silica such as silica bricks or refractory bricks for furnace linings. These substances, as well as silica glass are made by fusing silica at high temperature.

Chalcedony and flint are sometimes classed as colloidal forms of quartz. Chalcedony has no crystalline properties which are visible to the naked eye, and the optical properties of flint are undetermined. These substances consist of quartz fibers interspersed with hydrated silica, or opal.

Silica also occurs in amorphous hydrated form such as opal and diatomaceous earth, sometimes called kieselguhr. This type of silica is more easily soluble than quartz.

Quartz rock is found in nearly half of the states of the United States, and sandstone is present in practically all. Sandstone and ground sand, however, are produced chiefly in Illinois, Missouri, New Jersey, New York, Ohio, Pennsylvania, Virginia, West Virginia and Wisconsin.

Diatomacous earth, which is composed of silicous skeletons of microscopic aquatic plants (diatoms) is present in deposits located in California, Oregon, Nevada, Utah, Washington, Connecticut, Maryland, New Hampshire, New York, Virginia and Florida.

USES OF SILICA	TYPES OF SILICA USED
Abrasive Uses; scouring and polishing soaps and powders.	Quartz, Quartzite, Flint, Chert, Sandstone, Sand, Tripoli and Diatomaceous Earth; all in finely ground states.
Sandpaper	Quartz, Quartzite, Flint, Sandstone and Sand; coarsely ground and closely sized.
Sandblast Work.	Quartz, Quartzite, Sandstone, and Sand, pressed into sharp angular grains uniform in size.
Metal Buffing, Burnishing and Polishing.	Ground tripoli and other forms of ground silica.
Sawing and Polishing Marble and Granite.	Sharp cleaned sand graded into various sizes.
Whetstones, Grindstones, Buhrstones, Pulpstones, Oilstones.	Massive sandstone from very fine to moderately coarse grain.
Tube Mills.	Chert, flint and quartzite.
Lithographer's graining sand.	Medium to fine sand or rather coarsely ground silica and tripoli.
Tube Mill Grinding Pebbles.	Round flint pebbies.
In tooth powders and pastes.	Various forms of pure silica finely ground.
Wood polishing and finishing.	All forms of silica to medium fineness.
Refractories uses: in making silica fire brick and other refractories.	Fairly pure quartzite known as ganister; not less than 97% silica tightly interlocking grains desired.
Metallurgical Uses: In making silica ferro-silicon and silicon alloys of other metals such as copper.	Moderately pure sand massive crystalline quartz, sandstone, quartzite, or chert. Has a melting basic ores. Massive quartz and quartzite.
Foundry-mold wash.	Ground sandstone, quartz and tripoli.
Foundry Parting sand.	Ground sand and gravel tripoli.
Chemical Industries: As a lining for acid towers and massive quartz or quartzite. As a filtering medium massive diatomaceous earth and tripoli form a sand, finely granular quartz or quartzite, finely ground tripoli, diatomaceous earth and other forms of silica.	
In the manufacture of sodium silicate.	Pure pulverized quartz sand, pure tripoli and diatomaceous earth.
In the manufacture of glazes.	Pure quartz sand.
Paint As an inert extender.	Finely ground crystalline quartz also finely ground sandstone, and sand and tripoli.
Mineral Fillers As a wood filler.	Finely ground crystalline quartz, quartzite, flint tripoli and other types of ground silica.
Fertilizers	Finely ground silica of all types.
Insecticides	
Fillers in rubber, hard rubber, pressed molded goods, phonograph records, etc.	
Road asphalt surfacing mixtures.	
Ceramic Uses which comes under the word Mineral Fillers above.	
Potters Industry as an ingredient of bodies and glazes.	Flint, tripoli and chert, and other amorphous silica preferred; also other forms of very pure silica all finely ground.
Manufacture of Glass	Pure Quartz sand.
Manufacture of fuse cord, chemical apparatus such as tubes, crucibles and dishes.	Very pure massive quartz preferred.
Decorative Materials In the manufacture of gems, crystal balls, table tops, vases, and statues, rock crystal, amethysts, rose quartz, citrine quartz, smoky quartz, chrysoprase agate, chalcedon, opal, onyx, sardonyx, jasper.	
Insulation	Massive and ground diatomaceous earth.
Heat insulation for pipes, boilers, furnaces and kilns.	
Sound insulation in walls, between floors, etc.	Massive and ground diatomaceous earth.
Structural materials Sand-lime brick.	Moderately pure sharp angular sand probably finer than 20 mesh together with a small percentage of finely pulverized silica.

Silica dust appears especially in hard rock mining, excavating, tunnelling, blasting, etc.; granite and slate quarrying, metal grinding, sand blasting, pottery making, vitreous enameling, manufacture of abrasive powder, soap stone, and soap stone products manufacturing, brick and clay products manufacturing and in certain parts of foundry operation. It may also be present in connection with agate and enamelware manufacturing, refactory products manufacturing, terra cotta manufacturing, and in the manufacture of glass in its different forms.

Silicosis, the disease produced by silica, is caused by breathing the dust. The particles become lodged in the lung tissues where they have an irritating effect which causes the growth of fibrous or scar tissue. This gradually takes the place of the normal lung tissue and the condition leads to an increased susceptibility to tuberculosis. The particles too small to be seen are the most dangerous. The disease develops slowly, depending on the amount of dust in the air, the proportion of silica in the dust, and the steadiness of exposure. In small amounts silica may be found mixed with many different kinds of dust.

At the present time a great deal of study is being given to the best methods of controlling the silicosis hazard. The following rules have been effective for a long time and are still of extreme importance:

1. Control dust at the point of origin by use of wet methods or special exhaust ventilation. The water saturated dust dries out and again becomes a hazard if not removed.
2. Have the dust of work places examined to find out how much silica it contains. If over 30% silica is found in the dust the air should be purified so that the amount of dust is less than five million particles (under 10 microns in size) per cubic foot.
3. Sand blasting should be done only with the articles completely enclosed or the workers protected by positive pressure helmets.
4. Alternate dusty work with non-dusty work as often as possible.
5. Have a physical examination, including an X-ray examination of the lungs, of all employees before employment, and have periodic X-ray examinations of the lungs of all exposed workers at intervals not greater than one year.
6. Substitute steel shot for sand in abrasive blasting.
7. Use approved respirators against silica dust for short exposures.

ARSENIC POISONING

Arsenic, the metal, is a brittle, steel gray substance which is harmless, but poisoning occurs from every compound of arsenic. The most poisonous solid compound is white arsenic or arsenious acid. The best known compounds in industrial use are Paris green and Scheele's green composed of mixtures of arsenic and copper. Arsenic vapors having a yellow color and characteristic garlic odor are given off when arsenic compounds are heated.

Arseniuretted hydrogen gas, an extremely poisonous gas with no color and a bad smell, is produced when acids act on metals containing arsenic.

Arsenic compounds are used in industry in preserving furs, feathers, and skins; when removing hair from hides; making artificial stones and enamel; decolorizing glass and crystal; in black or green bronzing, the manufacture of insecticides, in the chemical industry and preparing green dyes and paint. The ores of many metals, such as copper and lead contain arsenic.

Poisoning occurs by breathing the dust or vapors of arsenic compounds or taking arsenic compounds into the mouth. Arsenic may also enter the body through the skin if the skin is broken. While arsenic and its compounds are used far more in medicine than in industry, they do occur sufficiently often to warrant extremely careful attention whenever they may be found in use during the course of an inspection.

Control of the arsenic hazard is based upon the following requirements.

1. Work rooms should be well ventilated and arsenic dust and vapors should be removed at the point of origin by suitable exhaust ventilation.
2. Work tables with down draft exhaust ventilation should be used where arsenic dust is produced.
3. Arsenic fumes should be eliminated by passing them through coke and nitric acid.
4. Floors of work room should be of cement to prevent absorption and permit easy cleaning.
5. Receptacles for arsenic compounds should be of metal to prevent breaking or leakage.
6. Overalls, gloves, and masks should be supplied to workmen when necessary.
7. Floors of work room should be cleaned daily by washing down with water or with a vacuum cleaner.
8. Proper sanitary facilities should be supplied to workmen and they should be encouraged in the practice of personal cleanliness.
9. Physical examination should be made of all employees before working with arsenic, and then thereafter at least once a year on a regular basis.

CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, extremely deadly gas. It gives no sign of its presence and can only be detected by special apparatus. It is produced when wood, coal, coke, gasoline, or any other substance containing carbon is incompletely burned.

It is always found in the exhaust from gasoline engines and it makes up about twenty to thirty per cent of the content of ordinary illuminating gas. It is found in the air wherever defective gas appliances are used, such as ironing machines, soldering machines, hat pressing machines, gas furnaces, etc., and wherever motor cars are run in garages or shops. It is found also in the following industries: Testing of gas meters, repair of gas mains, location of gas leaks, blasting operations and explosions as in mines, care of furnaces in factories, in steel mills, and in the distillation of coal tar.

The body must have plenty of oxygen all the time. Oxygen is supplied to the blood by means of the lungs through the air that is breathed, but, if carbon monoxide is in the air, the blood takes it up instead of oxygen and the body suffers from oxygen starvation. Carbon monoxide can cause sudden collapse and death without any previous symptoms, but usually various symptoms occur. The commonest of these are headaches, dizziness, drowsiness, weakness, confusion, nausea or vomiting. palpitating of the heart, and throbbing in the head. When these symptoms are felt. serious poisoning can be avoided as a usual thing if fresh air is reached immediately.

Proper control of the carbon monoxide hazard is based upon the following precautions:

1. Adjust flames, drafts. and equipment so that carbon monoxide will not be formed.
2. Remove carbon monoxide when it is unavoidable. at the point of origin by special exhaust ventilation.
3. Have the air of work room tested for carbon monoxide. The concentration of this gas should not be allowed to reach two parts in ten thousand parts of air.
4. Provide all service gas masks where exposure is unavoidable.
5. In industries where carbon monoxide is present in excess of two parts per ten thousand parts of air, an oxygen-carbon dioxide inhalator should be available. Special attention must be paid to reducing the dangers from gas heated appliances and gasoline motors.
6. All gas appliances should be installed by competent persons and used only when made by reputable manufacturers. Wornout or second hand equipment should be avoided. All such equipment should be inspected periodically and appliances and connections repaired when necessary.
7. Garages should install a general ventilating system or arrange for the removal of gas direct from the exhaust pipe of the car. The motors of automobiles should not be allowed to run for more than thirty seconds within the garage unless there are special ventilating arrangements.

The diagnosis of carbon monoxide poisoning depends mainly on exposure and symptoms. The gas can seldom be found in the blood. as it disappears from it entirely within four hours. Fresh air is all that is necessary for mild cases, and those exposed to carbon monoxide and showing indications of faintness. sleepiness or drowsiness should be taken into the fresh air at once. For acute cases. artificial respiration in the fresh air by the Schaefer method should be started at once and continued until the patient can be removed to a hospital. It is therefore, essential that the proper method of applying artificial respiration be taught to all whose work may bring them in contact with this gas.

METALLIZING

One method that is being used quite widely at the present time for applying protective coating to metallic surfaces is that of metallizing. This consists of spraying molten metal on the surface which is to be protected. It may, also. be necessary to clean the surface to be sprayed by sand or steel abrasives which introduces still another hazard which is discussed elsewhere in this manual. The metallizing is done by feeding a strip of metal wire into oxy-acetylene or oxy-hydrogen flame. The metal wire is melted by the flame and carried forward by the force of the gas pressure to the surface to be covered. The concentration of very fine dust or fumes are extremely high and in cases where material such as lead. cadmium or materials containing these substances are sprayed there is a very serious hazard. Wherever this work is done a positive pressure helmet should be used. This is the only possible method of protection where poisonous metals are sprayed. In inspections of risks where this type of work is carried out information should be obtained as to the kinds of metal sprayed. the type of protection used at the present and also the type of protection that was used in the past by the present workmen. This particular operation is extremely hazardous and severe illness has resulted as the result of several hours exposure.

DUST HAZARDS

PART I

The literal definition of pneumconiosis is "dusty lung." not necessarily "damaged lung." In the past. it has been used as a general term to designate abnormal conditions of the lungs that may result from the inhalation of dust. Clinical observations and medical research indicate that silica ($Si\,O_2$) is the most damaging element of the various inorganic dusts.

Silicosis, as defined by the American Public Health Association, is a disease due to breathing air containing silica. characterized anatomically by generalized fibrotic changes and the development of miliary nodulation in both lungs; and clinically by shortness of breath. decreased chest expansion. lessened capacity for work. absence of fever. increased susceptibility to tuberculosis (some or all of which symptoms may be present), and by characteristic X-ray findings.

Briefly, fine particles of free silica may penetrate into the lungs where they are picked up by certain migrating cells whose function is to remove foreign substances from the lungs. When the amount of silica in the lungs is such that these cells cannot take care of it, they die and build up coarse fibre-like tissues in which the tuberculosis germs. if present, may flourish. The progress of the disease is generally slow and may take a number of years. Once contracted. it is considered to be progressive and may result in total disability or death from silico-tuberculosis.

Only dust particles less than 10 microns in size (one micron equals one 25,000th of an inch) are found in the lungs. Larger particles are. therefore. considered to be less harmful. Silicosis can be prevented only by protecting the worker from dust containing free silica and serecite (white mica) although no inorganic dust should be considered as non-hazardous until definitely proved so.

Asbestosis is a disease, in some respects similar to silicosis, caused by the inhalation of asbestos fibres. Its clinical features include the slow development of a characteristic type of fibrosis (fibrous tissue). Because asbestos dust consists of fibres, it does not penetrate as deeply into the lungs as does silica dust, and, instead of killing the migrating cells (phagocytes) it lodges in the walls of the bronchioles (air passages) producing fibrous tissue which tends to constrict these passages. Infections, such as tuberculosis, are not so frequent as with silicosis. Asbestos fibres may constrict the blood vessels in the lungs, resulting in an overtaxed heart and heart trouble. An individual may be free from symptoms for a number of years, although exposure of a very few years has produced definite symptoms. The prevention of asbestosis must be accomplished through dust control measures.

Anthracosis and *siderosis* are types of pneumoconiosis resulting from the inhalation of coal and iron ore (siderite) dust respectively. In the absence of silica, these dusts produce a fine diffuse fibrosis in the lungs, accompanied by pigmentation — black and red respectively — due to the color of the substances. In neither case does disability result. From a practical standpoint, dust in hard coal mines usually contains free silica and may produce anthraco silicosis. Most hematite ores are associated with free silica and can produce disability.

It is generally considered that the development of these forms of pneumoconiosis is based on these factors: (1) The concentration of dust in the air: (2) The proportion of the free silica or asbestos (as the case may be) in the dust: (3) The length and continuity of exposure. There may also be individual susceptibility, but, from an engineering standpoint the first three named factors are the principal ones.

This, therefore, means that the higher the proportion of free silica (quartz) or asbestos in the dust of the air that is breathed, the lower should be the total concentration of dust. On the other hand, if the silica or asbestos content of the dust is low, it is believed that higher total concentrations of dust can be breathed without physical impairment. However, there is an upper limit of dustiness, irrespective of the nature of the dust, beyond which certain types of lung conditions may develop if this dusty air is breathed. This limit is at present considered to be 50,000,000 particles of dust per cubic foot of air.

PART II

Silicon is one of the most abundant elements in nature. Free silica is silicon dioxide ($Si\,O_2$) as differentiated from physiologically inert silicates which are metal salts of the hypothetical silicious acid (i.e. $Ca\,Si\,O_3$, $Ca\,Al_2\,Si_2\,O_8$). It occurs either as a principal constituent or as an impurity in most ores, rocks, clays, sands, and other inorganic substances of industrial importance — the higher the percentage of silica the greater the health hazard.

QUARTZ, QUARTZITE, FLINT, CHERT, TRIPOLI, DIATOMACEOUS, EARTH, SAND, AND SANDSTONE, (5) are the most common forms of silica, varying only in creptalline form and occurrence in nature.

A reasonable standard of permissable dustiness for inert dusts is as follows:

	Million particles per cubic foot of air
When associated with no quartz	— 50
" " " low "	— 30
" " " 30% "	— 15
" " " 100% "	— 5

these standards are *purely arbitary*, being based on experience plus slight medical evidence.

ASBESTOS is a fibrous mineral widely used in industry. CHRYSOTILE (H_4, Mg_3, Si_2, O_9) is its most common form. Certain varieties of *Tremolite*, *Amphibole*, *Serpentine* and *Anthophyllite* are also known as Asbestos, although of lesser industrial importance. The handling of asbestos generates a dust compound of fine fibrous particles which when inhaled over a period of time, may cause asbestosis.

GRANITE dust contains about 30% free silica and is one of the worst offenders in the causation of silicosis. The frequency of silicosis, tuberculosis, bronchites, pneumonia and other respiratory ailments is abnormally high among workers exposed to granite dust.

MARBLE AND LIMESTONE are composed principally of calcium carbonate which is physiollogically inert. Unless silica is present in excessive amounts, this class of rocks may be considered relatively non-hazardous.

CHALK mostly calcium carbonate of fossil origin may be included in this group.

SANDSTONE, a rock consisting mainly of particles of quartz sand cemented with silica, is used in grinding wheels and in building material. Its high silica content renders it a definite occupational disease hazard.

MICA AND SERECITE (White Mica) are possible offenders as causes of silicosis. Wherever possible, the use of sand containing needle-like crystals of serecite should be avoided.

GYPSUM, PLASTER OF PARIS are principally Calcium sulfate and do not present a serious hazard.

CARBORUNDUM (Silicon carbide, Si C) ALUNDUM, ALOXITE, CORUNDUM (Oxides of Aluminum) are widely used as artificial abrasives, especially in grinding wheels. An investigation revealed no unusual hazard in breathing the dust of these substances.

COAL OR CARBON dusts, in the absence of free silica may produce a mild fibrosis with discoloration of the lungs, but are not disabling.

CEMENT DUST usually contains from 1% to 6.5% or more free silica. The frequency of respiratory ailments among workers exposed to cement dust (dustiness ranging from 22 to 63 million particles per cubic foot of air) is about twice that of workers in non-dusty trades.)

TALC (Soapstone) is used in toilet powders, as a filler in paper manufacturing, in slate pencils, etc. Talc usually contains impurities especially tremolite. Talc dust containing 40% or more tremolite may induce a fine diffuse bilateral fibrosis of the lungs which is demonstrable in the X-ray. In the absence of free silica it cannot be said to be disabling.

SLATE dust reacts in a manner similar to high-tremolite talc.

GEORGIA TALC dust containing only 10% tremolite with traces of free silica has produced a high frequency of pneumonoconiosis and tuberculosis.

ORGANIC DUSTS (Wood, fur, textiles, leather, etc.), are not pneumonoconiosis producing but may exhibit irritating or toxic properties, depending on the nature of the substance.

DUST CONTROL

In industrial hygiene work, the following are the chief factors in determining the dust hazard.

1. The nature of the dust
   (a) Its composition
   (b) Its particle size properties
2. The concentration of dust in the air
3. The degree of exposure of the workers to dusty air
4. Its physiological action, whether it is
   (a) Physiologically inert
   (b) Capable of producing an allergic reaction (hay fever)
   (c) Toxic — (lead, etc.)
   (d) Capable of producing pneumonoconiosis

Dusts are solid particles generated by the mechanical disintegration of solid organic or inorganic materials. A dust cloud may be composed of billions of particles of varying sizes and shapes, each visible particle accompanied by many minute particles visible only under the microscope. As the dust is generated the larger particles settle out with a velocity depending, among other things, on size. The smaller particles settle out more slowly and may be caried throughout the plant by air currents.

In a material of uniform properties, the average particle size is the same as the size of the individual particles, and a chemical analysis by weight can be applied numerically.

In an industrial dust cloud, however, there is a wide variation in the sizes of the individual particles. One large particle of quartz will weigh more than one hundred small particles of feldspar. A chemical analysis reported by weight will show the presence of over 50% quartz, by number, less than 1%.

In occupational disease work we are interested in the *number* of particles of quartz less than 10 microns in size per cubic foot of air, since the frequency of respiratory diseases was correlated to numerical dust counts.

Because of the difficulty in distinguishing free silica from combined silica, chemical analysis must be accompanied by petrographic analysis in which minerals are identified by their optical properties.

Dust particles in the air may contain a positive or negative electro-static charge. The attraction between particles of opposite electrical properties causes them, upon contact, to cling together, a process known as flocculation. Flocculation increases the settling rate of a dust cloud.

In dealing with this problem, a dust cloud must be visualized as a suspension of non-uniform particles of constantly varying size, percent composition, of irregular concentration and unpredictable behavior.

The first step in dust control work is to determine the concentration of dust in the air, involving the collection of dust from the air and its quantitation by laboratory means — making dust counts.

Dust counts are reasonably accurate approximations of the number of particles of dust contained in a given volume of air. The information, when obtained, merely signifies that at that particular instant and location, the sampling device used collected the determined amount of dust. A sample taken shortly afterwards under different weather conditions, or in a slightly different location will vary considerably. An instrument sampling small volumes of air will produce a greater percentage of error than will an instrument sampling large volumes of air.

To obtain a representative picture of conditions, it is necessary to average the results of a number of large volume samples taken in the same spot over a long period of time, employing an instrument of known efficiency against all particle sizes of the given dust.

When dust in the air is visible we know the hazard exists, when not visible, dust counts should be employed.

The earliest practical instrument for sampling dusty air was the Konimeter (dust meter) developed by engineers in the South African mines. A measured volume of air is drawn by a small hand piston through an orifice and impinged at high velocity upon a circular glass plate which is usually coated with a film of gelatin. The dust in the air sticks on the plate in a spot roughly circular, and can be counted directly through the attached miscroscope. While this instrument is of low efficiency and can sample only very small volumes of air, it can take 30 samples on one plate, is compact, and obviates the necessity of laboratory counting. It was used successfully in South Africa as a comparative instrument, and aided materially in South African dust control work.

The *Owens meter* was first used to sample atmospheric dusts. A hand piston draws the dusty air through a tube lined with wet blotting paper which serves to humidify the incoming air. The air passes through a slit orifice, and expanding, is chilled, causing the moisture in the air to coat the dust particles with water. The coated particles are impinged on a small cover glass, opposite the orifice, in the form of a ribbon. The particles in this ribbon are counted under a miscroscope, usually employing oil immersion methods. The Owens jet meter is very efficient for extremely fine dusts. For industrial dusts it is about 40% efficient, but its compactness and simplicity render it invaluable. Like the konimeter it takes small "grab" samples and unless used properly may give misleading results. The principal disadvantage of the Owens instrument is that a new cover must be inserted for each sample, and in changing, exposes the clean slip to contamination from dust in the air. A variation of the Owens meter will be brought out shortly in which many samples may be taken without changing the glass plate.

BAUSCH AND LOMB DUST COUNTER — This is an ingenious improvement on the Owen's Jet Meter that has just recently been put on the market. It counts the particles by the dark field technique which give much higher results than the impinger. The chief objection at the present is that it gives abnormally high results in the presence of smoke which constitutes little hazard. It will doubtless be improved or modified in the near future.

The standard method of dust sampling in American (U. S. Public Health Service Technique) employs the *Greenberg-Smith impinger* apparatus. This method is invaluable because it was used to establish correlation between dust conditions and the frequency of respiratory diseases.

Dusty air is drawn, at constant rate, through a glass tube and impinged against a flat plate immersed in water. The force of the impingement coats the dust particles with water and they remain suspended in the liquid. The clean air passes out through a baffled tube. Suction is supplied by an electric suction pump or by a compressed air ejector. A known volume of the dusty water is placed under the microscope and the particles counted.

The advantages of the impinger apparatus are that it samples large volumes of air, can be left running for hours without attention, and is the standard method for this country.

Its disadvantages are that it is bulky and hard to transport, is fragile and expensive, and dusts so collected cannot be measured directly.

There are two instruments claimed to be 100% efficient, the *electric precipitator* which utilizes an electric field to deposit the dust particles on a celluloid cylinder; and Green's *thermal precipitator*, utilizing heat waves for the same purpose. Of these instruments, one is useful in the laboratory only and the other is still in the early stages of development.

Several short-cut methods of sampling and comparative quantitation are available for routine plant operation.

There are four general methods of dust control arranged below in order of their effectiveness.

1. Substitution of Process
2. Isolation of Process
3. Removal, dilution, or suppression of dust at its source
4. Respiratory Protection

In many plants, materials containing silica are used in dusty operations for which non-silicious materials may be substituted. For example, in sand blasting, the use of metal abrasive instead of silicious sand will reduce the dust hazard considerably. Flint, used in packing kilns, may be replaced by another less hazardous material. Sometimes a dusty operation or a defective or dusty machine may be replaced by another with consequent increase in efficiency and decrease in dust dispersion.

If substitution is not feasible it may be possible to isolate the process either by use of a separate building, a sealed enclosure, or by carrying on the operation at night when fewer workers will be exposed. For example, the shaking out of large castings in a foundry may be done at night by a few well protected men, thus preventing all other workers from inhaling the dust during the day.

The most practical method of dust control is that of (1) suppression, (2) dilution, or (3) removal at the point of generation.

It is possible to produce dust without dispersing it and a non-dust producing operation may disperse accumulated dust from other operations without producing any of itself. The actual mechanical force that generates the dust is not sufficient to project the tiny particles very far into the air. It is the vibration and air motion incidental to the operation that carries the dust into the plant air.

Therefore, the suppression of dust (preventing its dispersion) at its point of generation by the use of water or oil sprays is not always practical, because the wet dust accumulates, dries and is then dispersed by air currents, etc. The use of wet drilling in mines is effective in protecting the driller, but the wet dust clings to the tunnel, dries, and is dispersed into the air when blasting is done. There are instances, however, when a water or oil spray coupled with exhaust ventilation is a very useful method.

There are cases when a dust cloud of hazardous concentration may be diluted to a safe point by the introduction of large volumes of fresh air. However, the air currents from the blowers are apt to stir up dust that has settled on beams and floors, resulting in a still higher dust concentration. For this reason, the method is seldom practical.

Exhaust ventilation is the most efficient method of controlling dust at its point of generation. An exhaust system is composed of four parts.

1. The exhaust hood
2. The piping for pneumatic transport of the dust
3. The dust collector
4. The blower

Each part is a specialized problem in itself.

The purpose of the exhaust hood is to maintain directional air motion into the system greater than that of the dusty air. To accomplish this it must counteract the kinetic energy of the projected particles, and overcome the various divergent air currents fundamental to the process but which are the dust dispersing agents, and then draw the dusty air into the system.

The hood should enclose and be located as close to the process as possible. A round hood 6" in diameter producing an inward air velocity of 100 feet per minute at the center of its face will produce a velocity of only 7.5 feet per minute at a point 6" out from its face. An exhaust hood must be designed to meet the requirements of each individual problem.

The piping of an exhaust system provides the pneumatic transport of the dust from the hood to the dust collector. To withstand the abrasive action of the dust it should be constructed of heavy gauge metal and made free from sharp bends and obstructions. A chip trap to catch the larger particles of dust will prolong the life of the system and protect the dust collector.

The dust collector removes the dust from the dusty air either by filtering, by centrifugal force, or by trapping on a viscous surface.

The bag-filter dust collector is the most feasible type if properly installed and maintained. The cyclone type is not efficient against the small dust particles. Dust collectors should be installed in such a way that they can be emptied out of doors.

The exhaust blowers should always be located on the downstream side of the dust arrester in order to avoid the wearing action of the dust.

Only centrifugal blowers will operate efficiently in an exhaust ventilating system.

Propellor type fans are useful only in moving small quantities of air against low resistance such as through a partition.

Good plant housekeeping is an important factor in dust control work. Beams, floors, passageways and machinery must be vacuum cleaned or swept frequently. Unused machinery and unnecessary materials act as dust traps, collecting dust and hindering its removal. Leaky gaskets, valves, compressed air lines, and defective machinery are dust dispersers.

All emery wheels, sand blast units, tumbling barrels, finishing machinery, pneumatic drills, sand cutters and slingers, mills and pulverizers should be exhausted. In designing a new plant it would be wise to minimize all flat surfaces upon which dust will collect.

In the event that the above three methods of dust control are not practical, it will be necessary to resort to respiratory protection for the individual workman. There are four general types of respiratory protective devices.

1. Filter type dust respirators
2. Chemical cartridge respirators
3. Cannister type gas masks
4. Helmets supplied with clean air.

The chemical cartridge respirator and the cannister type gas mask are designed to protect against low concentrations of poisonous gases and fumes provided that there is sufficient oxygen to support life.

The filter type dust respirator may be worn in low concentrations of dust.

The air helmet with a positive pressure air supply may be used against high concentrations of dusts or fumes.

Only devices approved by the United States Bureau of Mines should be used. At best, respirators are uncomfortable and impractical and should be used only when all other methods fail.

TOXIC GASES AND VAPORS

Poisonous gases and vapors may be divided into four main groups as follows:

I Asphyxiants
  (A) Simple (Carbon dioxide, nitrogen, etc.)
  (B) Chemical (Carbon monoxide, hydrocyanic acid)

II Irritants
  (A) Affecting upper, or upper and lower respiratory tracts. (Acid fumes, Sulphur dioxide)

DUST, FUME AND MIST RESPIRATORS

APPROVED BY U. S. BUREAU OF MINES

TYPE A For protection against *pneumoconiosis-producing or nuisance dusts* (quartz, asbestos, iron ores, cement, limestone, gypsum, coal, coke, charcoal, wood, cellulose, flour, aluminum, etc.). Nos. 18, 20, 21 and 22 also bear Type A approval.

1.	M-S-A Comfo Respirators #8393	(#2101)	$2.25
2.	M-S-A Dustfoe Respirator	(#2115)	$2.25
3.	Willson Respirator #300	(#2102)	$3.00
4.	Willson Respirator #400, 400F	(#2103)	$3.00
5.	Willson Respirators #4, 4F	(#2106)	$2.75
6.	Willson Respirator #100	(#2117)	$1.50
7.	Willson Respirators #200, 200F	(#2118)	$2.40
8.	Willson Respirator #750	(#2119)	
9.	Pulmosan Respirator #M-15	(#2104)	$2.00
10.	Pulmosan Respirator #M-1100	(#2109)	$2.00
11.	Pulmosan Respirator #D-4100	(#2120)	$2.00
12.	Biever Respirator	(#2105)	$15.00
13.	Dupor Respirator #24	(#2111)	$2.25
14.	Cesco Healthguard Respirator #90	(#2113)	$3.50
15.	A. O. Co. Respirator #R-1000	(#2121)	

These respirators are not approved for protection against poisoning by breathing dusts whose main harmful constituents are metals or their compounds, as antimony, arsenic, cadmium, chromium, lead, manganese, mercury, selenium, tellurium, thallium, uranium and vanadium, or protection against harmful smokes, fumes, mists, gases or vapors, or a deficiency of oxygen.

TYPE C For protection against the *mist of chromic acid as produced in chromium plating*, and the *mist produced by spray coating with vitreous enamels* whose liquid vehicle does not produce harmful gases or vapors.

16. M-S-A Comfo Respirator #8393 (U.S.B.M. Approval #2101, extended) $2.25

This extension of approval does not cover use against any lead-containing mist.

LEAD DUST RESPIRATORS Mechanical filter respirators for protection against *mechanically generated dusts whose main harmful constituent is lead*, such as lead dusts generated in manufacturing storage batteries, enameling, pottery making, rubber compounding, sand papering and chipping painted surfaces, paint making, preparing lithotransfers and mining, milling and processing lead ores.

17.	M-S-A Comfo Respirator for lead dust	(#2107)	$2.25
18.	Willson Respirators #400L, 400LF	(#2108)	$3.25
19.	Pulmosan Respirator #L-2100	(#2110)	$2.00
20.	Pulmosan Respirator #ML-3100	(#2112)	$2.00
21.	Cesco Healthguard Respirator #91	(#2114)	$3.50
22.	Cesco Healthguard Respirator #92	(#2116)	$2.25

Not approved for protection against lead fumes from heating and volatilization of lead, as in lead burning, soldering, smelting, type founding, etc.

MANUFACTURERS OF ABOVE EQUIPMENT

Nos. 1, 2, 16, 17.	Mine Safety Appliances Co., Pittsburgh, Pa.
Nos. 3, 4, 5, 6, 7, 8, 18.	Willson Products, Inc., Reading, Pa.
Nos. 9, 10, 11, 19, 20.	Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn, N. Y.
No. 12.	Standard Safety Equipment Co., 75 E. Wacker Drive, Chicago, Ill.
No. 13.	H. S. Cover, Station A, South Bend, Indiana.
Nos. 14, 21, 22.	Chicago Eye Shield Co., 2300 Warren Boulevard, Chicago, Ill.
No. 15.	American Optical Co., Southbridge, Mass.

Approved respirators and filters bear the approval numbers indicated. Only parts identical with those furnished by the manufacturer should be used in making renewals or repairs. The manufacturer's instructions for fitting the respirator to the face, for cleaning or changing the filter elements, for cleaning the respirator, and for caring for the respirator while not in use, should be closely followed.

(B) Affecting lower tract (lungs) only. (Oxides of nitrogen, phosgene, ozone)

III Volatile drugs and druglike substances

(A) Mild anesthetics. (Ether, gasolene, etc.)

(B) Anesthetics causing organic changes. (benzol, the higher alcohols, aniline, amyl acetate)

IV Inorganic and organo-metallic substances (Mercury vapors, lead tetraethyl)

SIMPLE ASPHYXIANTS act by excluding oxygen from the lungs or by diluting the oxygen in the air to a point below that required to support life.

CHEMICAL ASPHYXIANTS by combining with the blood or tissues do not prevent the victims breathing but do exclude the life-giving oxygen from the system. Carbon monoxide, for example, has an affinity for the hemoglobin in the blood about 300 times that of oxygen and by uniting with the available hemoglobin, prevents the transport of oxygen to the tissues.

The best treatment for asphyxia is artificial respiration and administration of a mixture of 93% oxygen and 7% carbon dioxide.

Class "A" irritants, (acid fumes, sulphur dioxide, ammonia, etc.) are so highly irritating that a lethal concentration is unbearable. Eyes, nose, and throat are attacked before these gases reach the lungs. This serves to prevent fatal gassing except when the victim cannot escape.

Class "B" irritants do not attack the upper respiratory passages but upon penetrating deep into the lungs undergo certain changes which render them harmful. Phosgene, for example, has no harmful effect until it decomposes in the lungs yielding hydrochloric acid. It gives no warning until too late to avoid its effects.

Extreme exposures to irritating fumes result in unconsciousness from which the victim may appear to recover completely. Unless he is immediately put to bed and kept warm pneumonia may develop, terminating in death from respiratory failure or from edema of the lungs, (flooding of the lungs by a fluid exudate). Under no circumstances should artificial respiration be given the victim, he should be kept absolutely quiet.

Fumes of groups III and IV are transported in physical solution in the blood to various organs and nerve centers, exerting systemic changes in those parts affected. Poisoning may be chronic (i.e. the accumulated effects of long exposure to low concentrations), or acute (more severe effects due to short exposures to high concentrations).

The mild anesthetics of group III may produce drunkenness or anesthesia according to concentration.

Substances such as benzol may produce permanent systematic changes, possibly terminating fatally.

Group IV includes mercury vapors, stibine, phosphine, arsine, lead tetraethyl, etc.

Some toxic gases and vapors may be absorbed through the skin and workers exposed to them should be properly protected.

Prevention of poisoning by these substances calls for local exhaust hoods, enclosed processes, proper clothing and careful hygiene. Chemical cartridge respirators may be used for short exposures to not more than 3% of a toxic vapor (excepting cyanides) as long as there is sufficient oxygen in the air. Helmets supplied with fresh air must be used in higher concentrations or when the nature of the gas is not known.

WAXES

CAUSES

Certain types of waxes are used to impregnate wire insulation to increase the dielectric strength or to give a slow burning insulation. Some of the waxes that are used for this work may offer a serious hazard. According to an article by the Halowax Corporation appearing in the "Weekly Underwriter," October 17, 1936 "a long exposure to the vapors of numerous coal tar production such as napthalene, tar oil, chlorinated diphenyl and many waxes will cause skin diseases." These waxes may be used either hot or in solution with carbon tetrachloride, ethylene, dichloride, benzol and toluol.

CONTROL

Exhaust ventilation should be used to remove the fumes of the heated waxes as well as the solvent vapors. Improper heating causes the evolution of excessive vapors and may destroy the original character of the compound due to local hot spots. Steam or oil jacketed equipment is recommended.

NOTES

An occupational disease report on a wire insulation risk should emphasize the following information.

1. What waxes are used?
2. Are the fumes from the wax dipping tanks removed by an exhaust ventilation?
3. Are there any reported cases of dermatitis or was there any other evidence of skin eruption noted among the workers?
4. How many other people work in the room where the wax dipping is carried out?

SOLVENTS

The use of solvents for dry cleaning, de-greasing, and for gum and resin mixtures is one that has involved a certain hazard. Unfortunately the perfect solvent is not known at the present. Solvents such as benzol which do an excellent job on *cleaning* are toxic, inflammable, and explosive. Solvents such as petroleum naptha are inflammable and explosive, although they do not offer as great a hazard from the toxicity standpoint.

The chlorinated hydrocarbons—while non-inflammable offer some hazard from the toxicity standpoint. High petroleum fractions sold as Stoddard Solvent or Solvasol etc. have a high flash point and are non-toxic, but are not as efficient as solvents as some of the more volatile or more toxic materials.

Care should be observed in making recommendations for the substitution of non-toxic solvents for toxic materials, because the possible increase in explosions hazard.

SOLVENT	TOXICITY	FIRE HAZARD
Benzol	High	High
Carbon Disulphide	High	High
Carbon Tetrachloride	Moderate	Low
Gasoline	Low	High
Chlorinated Hydrocarbons	Moderate	Low
Stodard Solvent	Low	Moderate
Banana Oil	Low	High
Acetates	Low	High

RESPIRATORY PROTECTION

GAS MASKS

It is essential that the proper type of gas masks be used, that it be in the best of condition, and that there is no oxygen deficiency in the area in which the mask is being worn. Most canisters are sold with materials intended to absorb only a few closely related gases. A canister designed to protect against ammonia for example, is useless against such gases as carbon monoxide, or hydrochloride acid fumes. In most industrial plants the gases which may occur are known before hand and the proper canisters should be provided. Canisters filled with only one type of absorbent material afford protection for a longer time than is possible with the all-service canister.

TYPE OF CANISTER FOR PROTECTION UNDER VARIOUS CONDITIONS

BLACK CANISTER

This type of canister contains over 600 cubic centimeters of activated charcoal. This affords protection against organic vapors, such as aniline, gasoline, benzene, ether, toluene and the like (not over 20% in air).

WHITE CANISTER

This canister contains over 600 cubic centimeters of soda lime or caustic soda. It affords protection against acid gases such as hydrochloric, sulphur dioxide, nitrogen peroxide, chlorine, and the like. (not over 1% in air).

GREEN CANISTER

Contains copper sulphate and charcoal or silica gel. It affords protection against ammonia gas not over 3%. The 3% limit cannot be long endured by the wearer because of skin irritation from the gas.

BLUE CANISTER

Contains "hopcalite" which catalizes the combustion of carbon monoxide with oxygen from the air and produces carbon dioxide. It is necessary to protect the "hopcalite" from moisture. It affords protection against carbon monoxide. Not over 3%.

RED CANISTER

Contains all of the other absorbents mentioned above but only in small amounts. It is the all-service mask which provides protection against all gases except high concentration of the simple asphyxants.

YELLOW CANISTER

Contains activated charcoal and soda lime. It affords protection against a combination of organic fumes and acid fumes.

BROWN CANISTER

Contains copper sulphate and charcoal with a filter pad for smokes and dusts. It affords protection against ammonia and smoke.

WITH A GREEN STRIP

Caustic soda impregnated on pads. It affords protection against hydro-cyanic gas. (Not over 2% in air).

A STRIP PAINTED ON THE CANISTER

Indicates that it is equipped with filter pads and will protect against smoke, dust, and musts. Gas masks should not be used in atmospheres deficient in oxygen. The flame of a candle or safety lamp is extinguished at 17% oxygen in air, and a man is not in serious danger until the oxygen falls below 14%. Where it is expected that there may be a deficiency of oxygen a hose mask or self-contained breathing apparatus should be used.

A gas mask should be disinfected after use with alcohol or a 2% solution of lysol and then dried in the open air.

A worker who uses a mask should test it before entering a contaminated atmosphere. The mask is put on in fresh air and the bottom opening of the canister is closed by hand and suction is exerted by inhaling until the face piece collapses. This vacuum should be maintained for at least fifteen seconds.

HOSE MASKS

A hose mask may be worn in any atmosphere regardless of oxygen content. The only location where trouble may occur is in high concentration of hydrocyanide where there is absorption of the gas through the skin. The hose mask is especially adapted for work in atmospheres contaminated with the vapors from gasoline and kerosene where the life of gas mask canister is of uncertain duration. The face piece of a hose mask is similar to that of a gas mask but the inside air is delivered through a length of hose by means of a centrifugal blower. It is generally operated by hand so that there is always some one on the outside watching the man in the contaminated atmosphere.

SELF-CONTAINED BREATHING APPARATUS

The self-contained breathing apparatus is generally a portable device and supplies an atmosphere of oxygen, which the wearer re-breathes while the carbon dioxide which is exhaled is absorbed by an alkali. Theoretically it has no objection since the wearer may enter almost any atmosphere and he is not handicapped by a length of hose. However, it is heavy and cumbersome, it is also expensive to purchase and to maintain, but is the only thing that can be used for certain types of rescue work particularly in mines. No-one should ever attempt to use this apparatus unless they have been thoroughly trained in its use and has personally inspected it to know that it is in perfect order.

RESPIRATORS

AIR-LINE RESPIRATORS: A positive pressure respirator which is a simplification of the hose mask is worn on such jobs as paint spraying. It is designed for work where there is no severe hazard to the wearer should he remove the device momentarily. It should not be used in dangerous atmospheres or for sand blasting. If the air supply is cut off the wearer simply removes the mask and moves out of the polluted air. It has the advantage of being light, fairly comfortable and cheaper than the hose mask.

ABRASIVE BLASTING RESPIRATORS

The most severe dust hazard is in the abrasive blasting of sand castings with sand as the cleaner. These devices should protect the workman against flying particles and should be supplied with clean air at sufficient pressure and volume to insure a slight but constant positive pressure at the nose and mouth. It has been recommended that at least six cubic feet per minute is necessary to keep dust out of the mask. Air line respirators, or mechanical filter type respirators should not be used for abrasive blasting, even if steel shot are used.

MECHANICAL FILTER OR DUST RESPIRATORS

There are satisfactory respirators made which protect against silica, asbestos, and mechanically generated lead dust. This type of respirator will not afford complete protection against the fumes from either heated lead or gases. Respirators are a poor substitute for dust control, but on certain jobs they may be used temporarily or until the dust control system has been installed. The United States Bureau of Mines has set up an approved schedule for dust respirators and if it is necessary to use respirators only those of the type approved by the Bureau for that purpose should be used.

CHEMICAL — CARTRIDGE RESPIRATORS

This type of protection may be used in low concentration of such greases as gasoline, sulphur dioxide and in certain paint spray jobs. This type of protection is used where the exposure causes discomfort rather than a serious hazard. It should not be used as a substitute for the air-line respirators or gas masks, in spite of the fact that it is much cheaper.

SCHEDULE 1 — AGRICULTURE

Trees, Spraying, Fumigating, etc. 0106

EXPOSURE

Poisoning from lead, arsenic, and other insecticides.

CAUSE

Poisoning from lead, arsenic, hydro-cyanic (Prussic acid from fumigating). Can be contracted by inhalation, digestion or by absorption through the skin. There is also a possibility of a certain amount of dermatitis in the handling of certain materials such as lettuce, jonquils, and wood among many other materials.

CONTROL

1. Personal cleanliness is important in the mixing and handling of these substances.
2. Respirators proved for lead dust should be used when these substances are dusted or sprayed.
3. When hydrocyanic acid is used a gas mask (with a green strip) should be used for protection bearing in mind that the gas can be absorbed through the skin.

NOTE

An occupational disease report on spraying and fumigating should emphasize the following information.

1. The type of poison used in the spray (lead sprays might tend to cause occupational disease, whereas the cyanide would be more likely to cause accidental death).
2. The amount of spraying or fumigation that is done.
3. Are the poisons handled wet or dry?
4. Experience of the men actually handling the material on this type of work.
5. Description of procedure when fumigating.

SCHEDULE II — MINING

EXPOSURE

Silicosis, Anthraco-silicosis. (Miners' asthma) Siderosis and other forms of pneumonoconiosis.

CAUSE

Silicosis can result from inhaling the quartz dust caused by drilling and blasting in the hard rock overlay, dykes, and veins. Anthraco-silicosis or miners' asthma occurs among miners in the anthracite coal mines who are engaged in drilling and blasting rocks in which the coal beds exist. Siderosis occurs among miners who are exposed to the dust from siderite, an important iron ore. The other pneumoconiosis may result where there are heavy exposures to dust that are not ordinarily considered harmful, but due to excessive exposure they may cause lung damage or change.

CONTROL

Blasting should be done at the end of the shift. In this way men will not be forced to enter extremely dusty areas immediately after blasting. Removal of dust at the point of generation by the use of one of the several dust traps. These are a sort of vacuum cleaner arrangement, which sucks the air from the drill hole and discharges it through a filter. The use of wet drilling used to keep down the dust where the use of suction is not practical. In order to keep the dust at a very low concentration the use of suction may be combined with wet drilling. The use of respirators both of the filter and positive pressure type may be used where the drilling is occasional. Some work has been done on the use of water screen which prevents the dust from the drilling face getting back to the point where other men are working. In cases of very dry mines where the cars and the mules kick up considerable dust. salt or calcium chloride may be sprinkled about and this will pick up enough moisture from the air to keep the dust down. It should be recalled, however, that dust control in mining is comparatively a recent thing and most miners have probably been exposed to high dust concentration for a period of years.

NOTE

An occupational disease on mining operations should emphasize the following information:

1. What is the silica content of the materials mined and the hard rock that is drilled?
2. The approximate length of service on mining operations of the workmen?
3. Are the drills equipped with dust exhaust?
4. What type of drilling is used?
5. How many employees are exposed to dust?
6. Are employees examined before employment?

SCHEDULE II — MINING (SPECIAL)

EXPOSURE

Fluoride Poisoning, silicosis and lead poisoning.

CAUSES

Fluoride poisoning results from exposure to calcium fluoride dust which is encountered in the mining of fluorspar. This may cause over a period of gradual degeneration of the bones.

Silicosis may be encountered in any mine in this classification where there is an exposure to quartz in the ore or overlay.

Lead poisoning arises from the inhalation of the lead carbonate and lead sulphide in the lead ores.

CONTROL

It is obvious that all of the precautions recommended under classification 1164 should be carried out. but due to the additional hazard of lead and fluoride poisoning it will be extremely difficult to eliminate the hazard from this type of operations.

1. Respirators approved by the U. S. Bureau of Mines for protection against lead dust should be worn on all dusty operations in mines of this type in addition to the other precautions.
2. All drills should be equipped with dust exhausts.
3. All blasting should be done at the end of the shift.
4. The passageway should be kept wet down either by the use of water or by sprinkling salt or calcium chloride.

NOTES

Occupational disease report on mining operations where poisoning as well as silicosis may occur should emphasize the following points:

1. What is the silica content on the materials mined and the hard rock that is drilled?
2. Length of service of the workmen?
3. Are all drills equipped with dust exhaust?
4. How many employees are exposed to dust?
5. Are employees examined before employment?
6. Is the mine a wet or dry?
7. How long after the shot do workmen return to the face?

SCHEDULE IV — QUARRYING, STONE CRUSHING, ETC.

Rock Excavation (From Schedule 26)	1605
Quarries — Crushed Stone, etc.	1622
Quarries — Dimension	1604
Quarries — N. O. C.	1624
Sand and Gravel Digging	4000
Stone Crushing — No Quarrying	1710
Slate Splitting including Quarrying	1639

EXPOSURE

Silicosis and other possible pneumoconiosis silicosis is caused by the quartz dust from drills and crushers. So-called "hard rock" is most apt to contain free quartz and therefore, be hazardous. The grading or screening of pulverized material from crushers may be extremely dusty unless done wet.

Sand and gravel digging do not seem to present any great difficulty except in the screening tower where the operations are done dry.

There are sometimes claims for other pneumoconiosis troubles, but as a general rule the non-silica type of dust does not bring about permanent total disability. Limestone and marble are considered harmless unless the overburden and dykes are hard rock and represent more than 5% of the work.

Slate Slitting contains little or no hazard.

CONTROL

1. Exhaust system on the jack hammer and drills.
2. The use of wet crushing and grinding may be used to keep down the dust concentration in some cases.
3. Where there is occasional exposure respirators approved for that type of work may be used.
4. Careful medical examination of employees before employment should be made in order to exclude silicotics and men with tubercular tendencies.

NOTES

An occupational disease report on quarries or crushers should emphasize the following information.

1. The character of the quarry: granite, limestone, gneiss, soapstone or marble.
2. The approximate percentage of quartz or free silica in the rock.
3. Describe in detail the method of quarrying.
4. Are hollow drills used?
5. Are pre-employment examinations made?
6. On crushers do the men appear to be subjected to excessive dust exposure continually.

SCHEDULE V — FOOD AND TOBACCO

Bakeries	2000
Beet Sugar	2030
Breakfast Foods	2016
Chewing Gum	2045
Chocolate	2042
Confectionery	2041
Corn Products	4703
Cracker Manufacturing	2001
Macaroni	2002
Milling of Grain	2014
Molasses	2020
Sugar Refining	2021

EXPOSURE

Dermatitis.

CAUSES

In most operations in which flour or sugar is handled by hand, there is a mild dermatitis hazard. It is not definitely known whether the dermatitis is caused entirely by personal sensitivity or partly by the character of the material itself.

Claims from pneumoconiosis are not justified and the hazard should not be considered.

CONTROL

There is little or nothing that needs to be done from the standpoint of engineering control.

SPECIAL

Aside from an occupational disease standpoint, the hazard to look for, especially with grain milling, is the possibility of dust explosion. Therefore, whenever any plant such as a grain elevator, corn products plant, or other similar industry is being inspected, the report should give in complete detail the hazards with respect to fire or dust explosions.

●

SCHEDULE V — FOOD AND TOBACCO

Butchering	2081
Meat Products, N. O. C.	2095
Packing Houses	2089
Stock Yards without slaughtering	8285

EXPOSURE

Anthrax — Erysipeloid — Dermatitis.

CAUSE

Anthrax and other similar cattle diseases that are common to man can generally be disregarded in the domestic packing industry.

Erysipeloid is swine Erysipelas. It comes from the bones of all animals and is produced in a punctured wound by the bone splinter which makes the puncture. It is considered as an occupational disease but is more of an accident and is generally compensable in the same manner as an infection.

While this type of injury does not cause very long disability, it is sometimes so high in frequency that the total losses may be considerable.

Dermatitis is caused by handling offal and by inadequate personal cleanliness and as an occupational disease is not very important control. None of these conditions lend themselves to engineering control; they are prevented by supervised and adequate washing facilities and by proper treatment of all cuts and scratches.

NOTES

The inspection reports should particularly emphasize the handling of bones and the bone splinters that might cause Erysipeloid. Bring out the following points in detail:

1. What are the washing facilities?
2. What are the first-aid facilities?
3. Is there general personal cleanliness??
4. Is there any program of supervised washing?
5. Have there been any hand infections?

SCHEDULE V — FOOD AND TOBACCO

Fish Curing and Packing 2101

EXPOSURE

Erysipeloid and Dermatitis.

CAUSE

1. Erysipeloid.
   (a) In this trade it is some times called "Fish Hand" and is exactly the same as the bone puncture infection described on the previous page.
   (b) The dermatitis is caused by the handling of curry and brine.

CONTROL

Personal cleanliness is the essential factor in preventing these conditions. Fish skinning and filleting by machinery reduces the exposure.

SCHEDULE VI — TEXTILES

Carpet and Rug Manufacturing ... 2402
Felting Mfg. 2288
Wood Scouring or Combing 2260

EXPOSURE

Anthrax.

CAUSE

Anthrax is caused by handling wool and inhaling dust from wool which is infected with anthrax germs and spores. It is found only in wool from certain foreign countries where the disease exists. Systematic poisoning from inhaling the dust is always fatal although it is rare.

CONTROL

1. Certification by consul that wool is from an uninfected area.
2. Knowledge of infected areas. (Information on this and Question number 1 can be obtained through the Federal Department of Animal Industry.)
3. Sterilization.
4. Adequate medical control through proper diagnosis and treatment. This is a very important subject and should be thoroughly discussed with the claim department.
5. Respirators should be worn in dusty operations or where infection is present.

NOTES

1. What are the methods followed by the assured to trace the sources of the wool, in order to determine possible infection?
2. What are the methods of sterilization?
3. Is the assured's medical department familiar with Anthrax and its treatment?
4. Are respirators used in any operations?

SCHEDULE VI — TEXTILES

Artificial Silk 2305

EXPOSURE

Poisoning from carbon bisulphide fumes, dermatitis, bronchial and eye irritation.

CAUSE

There are several chemicals which cause dermatitis in the artificial silk industry. Carbon Bisulphide fumes are poisonous and illness may result. Sulphuric acid used in the viscose process to coagulate the rayon, produces a mist which is irritating to the eyes and throat and may be considered as an occupational disease. It can, also, produce conditions of dermatitis.

CONTROL

Chemical operations should be enclosed or adequate hoods installed to remove fumes.

NOTES

The reports should bring out in complete detail the adequacy of fume removal.

SPECIAL NOTE

Fires and explosions have occurred in industries of this type. Therefore, all of your reports, whether occupational disease or regular inspection, should elaborate on these hazards.

SCHEDULE VI — TEXTILES

Textile Bleaching and Dyeing 2413

EXPOSURE

Chromium Poisoning.

CAUSE

Chromium poisoning in the form of irritation of the skin is caused by handling chromium salts used as a mordant during mixing of the dyes. Occasionally cases may occur from the vapors that arise from dye vats.

It is sometimes claimed that benzol poisoning may develop in this classification. This would be uncommon as there does not seem to be any benzol exposure.

CONTROL

Rubber gloves should be worn wherever possible in any operations where the hands may come in contact with the dyes and chemicals. Proper ventilation is very necessary.

NOTES

1. Are any chromium salts used?
2. Are rubber gloves provided?
3. Ventilating facilities should be described in detail.

SCHEDULE VII — CLOTH PRODUCTS

Hat Manufacturers (No blowing of Cones) 2537
Hat Manufacturing other than straw or cloth 2538
Hatters Fur Manufacturing (From Schedule IX) 2280

EXPOSURE

Mercurial poisoning and dermatitis.

CAUSES

Mercurial poisoning results from absorption through the skin of mercury from mercury salt used in the process of carrotting fur. When the mercury salt dries out on the fur they are liable to be thrown off into the air as dust when the fur is handled. In the forming, starting and sizing of the felt the fur is dipped in warm or hot water and is handled in this state. Particularly in the starting operation the men are exposed to absorption through the skin due to the handling of the warm, moist, felt. There is also a possibility of some of the unstable mercury salts being volatilized by the heat. On drying the carrotted furs mercury is given off as a vapor in dangerous amounts.

CONTROL

1. All fumes should be removed by exhaust ventilation.
2. The carrotting department should be isolated from the other work.
3. There should be exhaust ventilation in the carrotting rooms and drying rooms.
4. The men on the carrotting work should wear rubber aprons, rubber gloves and be provided with adequate washing facilities. The starting and sizing baths should be fitted with overflows and fresh water should be added continually. The baths should be dumped at night.

NOTES

An occupational disease report on a risk where mercury salts are used should emphasize the following information:

1. Is the hatters' fur carrotted on the premises?
2. Is the carrotted fur blown?
3. Is the exhaust ventilation adequate?
4. Has there been any trouble from the hatters' shakes?
5. Has there been any dermatitis?
6. Average length of service of the employee.
7. Complete description of all that has been done to eliminate the hazard of mercury poisoning.

SCHEDULE VIII — LAUNDRIES

Cleaning and Dyeing 2586

EXPOSURE

Benzol, Dermatitis.

CAUSE

1. There is occasional use of benzol as a first solvent. either alone or in mixture with another liquid. The fumes from it in very small quantities can cause chronic benzol poisoning.
2. The handling of solvents can cause dermatitis by reason of degreasing action of the solvent.

CONTROL

1. The use of benzol should be discontinued.
2. The handling of solvents and garments wet with solvents should be minimized.
3. Proper washing facilities should be supplied. Lanolin should be used after washing.
4. Employees who are particularly sensitive to skin irritations should be removed from exposure.

NOTES

1. Is benzol used in any form?
2. What is the extent of hand operations in connection with wet garments?
3. Have there been any cases of dermatitis in the past?

SPECIAL NOTE

The dry cleaning industry, or any similar industry using large quantities of volatile and inflammable liquids, presents a definite fire or explosion hazard. Therefore these matters must receive positive attention and be reported on in every such inspection.

It is generally accepted that solvents or cleaners for such use should have flash points in the range of 100 F. to 110 F. Stoddards Solvent is such a substance. There are on the market a large number of similar solvents.

SCHEDULE IX — LEATHER

Fur Manufacturing	2600
Hatters' Fur Manufacturing	2280
Tanning	2623

EXPOSURE

Anthrax, Chromium Poisoning, Dermatitis.

ANTHRAX — CAUSE

Anthrax is caused by handling skins and hides which are infected with anthrax germs and spores. Domestic hides are free from it, but foreign hides are infected, depending upon the area from which they come.

CONTROL

Certificate of foreign hides and skins: sterilization of those from infected areas. Regulations from Department of Animal Industry require certain procedures and many states require other procedures. Adequate medical control is, also, necessary for proper diagnosis and treatment. This should always be discussed with the claim department.

NOTES

1. What is the proportion of foreign skins and hides used?
2. Are the sources of hides and skins checked for possible infection?
3. What method of sterilization is used?
4. Is waste water chlorinated?
5. Is medical department familiar with anthrax and its treatment.

CHROMIUM — CAUSE

Chromium poisoning is caused by contact with tanning solution containing salts of chromium. Individual susceptibility is a factor, but usually the amounts of chromium salt solution in use are sufficient to affect most workers who are exposed.

CONTROL

1. Process should be arranged to avoid careless methods.
2. Adequate washing facilities should be provided and personal hygiene personally supervised. These two points are very important.
3. Highly sensitive employees should be removed from exposure.

SCHEDULE IX — LEATHER

Boots and Shoes Mfg. or Repairing 2660

EXPOSURE

Benzol, Dermatitis.

CAUSE

Dermatitis can be caused by (1) the solvent used in cleaning operations after completion of the shoe; (2) the solvent and preservative constituents of rubber cement in making operations. This last seems to be most pronounced in the "Compo" processes. The exposure is due to hand operations which do not admit readily of personal cleanliness. Personal sensitiveness is a great factor since there are often a dozen solvents used and different workers are sensitive to different solvents.

Benzol is now one of the less used solvents but is a distinct hazard wherever it may be used.

CONTROL

There is little that can be done in the way of engineering control. Personal cleanliness should be encouraged in every way. Evidences of dermatitis should be treated before they develop into serious cases. The use of lanolin after washing is helpful.

NOTES

1. What is the exposure to cements and cleaning solvents?
2. Is there evidence of cleanliness among employees?
3. Are proper washing facilities provided?
4. Is benzol used in any way?
5. Have there been any cases of poisoning or dermatitis?

SPECIAL NOTE

The possibility of fire or explosion hazards should always be considered and a complete report made thereon.

SCHEDULE X — RUBBER, COMPOSITION OR BONE PRODUCTS

Cables, and Wire Insulating	4470
Rubber Boots and Shoes Mfg.	4417
Rubber Goods, N. O. C.	4410
Rubber Reclaiming	4400
Rubber Tire Manufacturing	4420

BENZOL — CAUSE

Benzol poisoning is caused by the inhalation of benzol fumes if benzol is used in the manufacture of rubber, either in the rubber rolls or as a solvent in cementing and spreading operations.

CONTROL

Benzol if used should be replaced with other solvents. Exhaust ventilation systems should be used with down draft effect, particularly on bench and hand operations. The engineering reports should describe these conditions.

LEAD — CAUSE

Lead Oxide, Litharge is often a constituent of rubber. Exposure to it is limited to one or two men who weigh out the Litharge for rubber mixing.

CONTROL

Respirators should be used and medical examinations given. Lead pots should be ventilated.

NOTES

1. Is Litharge used in rubber operations?
2. Are respirators used?

SPECIAL NOTE

In connection with some of these clasifications there may be fire and explosion hazards. If so, a complete report should be submitted.

SCHEDULE X — RUBBER COMPOSITION AND BONE PRODUCTS

Composition goods. Plastic 4484

EXPOSURE

Benzol, Dermatitis.

CAUSE

In the manufacture of many composition substances called plastics, one of the main constituents is formalin or formaldehyde. With plastics in solid form, such as bakelite, casein plastic, the formalin is not a factor. Formalin itself is very irritating to the skin and mucous membrane.

If benzol is used as a solvent in any way, it can cause poisoning.

CONTROL

The hazard can be minimized by the following:

1. Use of other solvents for benzol.
2. Proper ventilation at the point of origin of the fumes.

NOTES

1. Is formalin used?
2. Is benzol used in any quantity?

SPECIAL NOTE

Whenever volatile and inflammable solvents are used in quantities in this or other similar classifications, complete report or the possible fire and explosion hazards should be submitted.

SCHEDULE X —

Horn bone, ivory goods 4485

EXPOSURE

Erysipeloid.

CAUSE

Erysipeloid is confined principally to those risks using bone such as in the manufacture of bone buttons. It is swine erysipelas from wounds caused by bone punctures such as described in meat and fish-packing operations. The frequency of such cases may be high.

CONTROL

1. Sterilization of bone. This is not possible in many instances.
2. Careful inspection by assured of employees' hands.
3. Constant care on the question of personal cleanliness.
4. Proper washing facilities with supervised washing.
5. Proper medical supervision of injuries.

NOTE

Strictly speaking this is not an occupational disease. However, it is included here and elsewhere, because its prevention from an engineering and medical standpoint is similar to certain types of occupational disease hazard.

SCHEDULE XII — PAPER AND PULP, PAPER PRODUCTS AND PRINTING

Abrasive paper and cloth preparation 1860 .

EXPOSURE

Silicosis.

CAUSE

Silicosis can be caused by sand dust that may be generated during various processes. It is not considered that emery and carborundum, used to coat cloth, are causes of silicosis. However, whereever there may be very dusty conditions by reason of the use of these two substances, other pneumonoconiosis or respiratory conditions may develop and be ascribed to the dust.

CONTROL

The hazards can be considerably minimized by

1. Installation of adequate exhaust ventilation systems over various operations.
2. Use of respirators wherever possible.

NOTES

In addition to other information, the inspection report should bring out in detail the following:

1. Is flint or quartz sand used?
2. What are the conditions of general dustiness?
3. Is dust removal equipment adequate?
4. Are respirators used?

SCHEDULE XII — PAPER AND PULP, PAPER PRODUCTS AND PRINTING

Lead Pipe (From Schedule 17) ..	3331
Linotype and Composition	4308
Newspaper Publishing	4308
Printing	4299
Sprinkling Manufacturing	3583
Type Foundries (From Schedule 17)	3336

EXPOSURE

Lead poisoning.

CAUSE

Cases of lead poisoning can result from inhaling lead fumes that come from the matrix melting pot, type casting machines and linotype machines. Cases of lead poisoning are infrequent in connection with hand composition or printing operations involving the use of lead base type.

A more serious lead poisoning hazard is present in connection with the manufacture of pipe lead than in the other classifications noted above, but the only reason for this is the greater volume of material that may be handled.

CONTROL

The following practices can be followed with respect to minimizing the lead poisoning hazard:

1. Install exhaust hood over the tanks and pots of molten type metal.
2. Proper medical examinations of those employees who are exposed to lead fumes, including blood examinations. This is an important step for an assured to consider, but it should be discussed with the Claim Department before making any such recommendation.

It is often necessary to provide artificial ventilation with considerable air velocity in connection with the hoods over melting pots and tanks. Natural stack ventilation is seldom efficient enough to remove all the fumes. Any lead in the molten state can produce fumes enough to cause lead poisoning and the low temperature of the molten metal cannot be used as an excuse for lack of ventilation.

It is necessary to have the best of medical advice in the medical control of lead poisoning. Employees should not endeavor to treat themselves with milk, lime water, cathartics, etc.

NOTES

In addition to other information, the following should be completely discussed in the inspection report:

1. What is the exposure to lead fumes?
2. Are ventilating exhaust hoods provided?
3. What are the medical arrangements?

SCHEDULE XII — PAPER AND PULP PAPER PRODUCTS AND PRINTING

Fibre Goods Manufacturing	4263
Paper Manufacturing	4239
Pulp Manufacturing — chemical process	4207
Pulp Manufacturing—ground wood process	4206

These particular classifications covering the manufacture of paper do not seem to present any definite occupational disease hazard, in the strict sense of the term. Some chemicals used for bleaching purposes, such as sodium sulphite, are irritants and occasionally cause conditions of dermatitis. Chemical recovery processes that are usually incidental to these classifications likewise do not seem to present any serious hazards.

SCHEDULE XII — PAPER AND PULP, PAPER PRODUCTS AND PRINTING

Engraving	4352
Photo Engraving	4351

EXPOSURE

Chromium poisoning, dermatitis.

CAUSE

While it is true that these two classifications cause little trouble from a health standpoint, there are occasional cases of chromium poisoning or dermatitis that arise. The chromium poisoning is usually in the form of hand irritation or ulcers. The conditions of dermatitis occur in all of the chemical processes, and in engraving it is found among the hand printers.

CONTROL

About the only thing that can be done is to insist upon care in personal cleanliness.

SCHEDULE XIV — WOOD

Planing or Moulding Mills	2731
Sash, Door or Assembled Millwork Mfg.	2737
Carpentry — Shop only — excl. comm. lumber yards	2802
Boat Building — Cabinet Works	2815
Veneer Products Mfg.	2915
Veneer Products Mfg.	2916
Pattern Making	2790
Wood Turned Products Mfg.	2794
Coffin or Casket Mfg. or Assembling	2804
Cabinet Works — With power driven mach.	2812
Tank, Seat or Cabinet Mfg.	2824
Billiard Table Mfg.	2870
Furniture Mfg. — Assemb. or Finish	2883
Organ Building	2920
Piano or Player Piano Mfg.	2923
Pipe Mfg.	2791
Woodenware Mfg.	2841

EXPOSURE

In any classification in which wood or wood products are finished with paint or lacquer, there may be cases of:

1. Lead poisoning from lead base paints.
2. Benzol poisoning from benzol that may be used as a lacquer thinner.

3. Dermatitis from hand operations such as rubbing and filing. This last-named hazard is not particularly important.

CONTROL

All spray painting that may be done in connection with these classifications should be done in booths that are properly equipped with ample exhaust and ventilation.

NOTES

The following conditions should be particularly emphasized in the inspection report. in addition to the other questions contained on that report:

1. Are lead-base paints used?
2. Is benzol used as a part of the lacquer or is it used in any other way?
3. Are spray booths in operation and are they properly exhausted?
4. Are there any hand operations that appear to be carelessly carried on?

In those cases where sanding machines are in operation. silicosis may be found among the operations of these machines. Whenever these machines are in use. they should be equipped with efficient dust removal systems and the inspection reports should explain this condition in detail.

SPECIALS — NOTE

Spray painting operations. where quick drying paints or lacquers are used. can present definite fire or explosion hazards. Therefore. such conditions should be carefully explained on the inspection report.

SCHEDULE XVI — METALLURGY

Lead Smelting, Sintering and Refining 1430
Metal Refining — No Ore Reduction 1413
Smelting and Sintering 1437
Smelting, Sintering or Refining — Metals N. O. C. 1438

EXPOSURE

Lead poisoning comes from inhaling the fumes or the smoke, or exposure to dust in crushing the ore. The hazard is definite when the ore is reduced to recover the lead. Lead smelting is the operation which contains the serious hazard. At times there may be intermingling of smelting operations in risks classified as metal refining.

CONTROL

High stacks and Cottrell precipitators. bag filters are used to remove the lead from the atmosphere. Hose masks should be used when workmen are cleaning precipitators on bag house. There should be some program of medical control in lead smelters.

NOTES

1. Describe the kind of ore that is smelted or the metal that is refined.
2. What is the approximate lead content?
3. What is the height of stacks used to carry off the fumes?
4. Are there any Cottrell precipitators in use to recover the metallic fumes?
5. What has been the experience with lead poisoning cases?
6. Are hose masks used when emptying or cleaning precipators?
7. Describe all methods of medical control.
8. What other means are used to keep atmosphere free from lead that may escape from stacks?

SCHEDULE XVI — METALLURGY

Ore Milling 1452

EXPOSURE

Silicosis.

CAUSE

Silicosis can be a serious hazard in this operation by reason of the quartz dust produced from the gold-bearing ores. Mercury poisoning is. also. a hazard that is present when there is amalgamation of the ore and the recovery of the mercury by distillation.

CONTROL

There is no satisfactory method of preventing the dust from stamp mills. Respirators should be worn. but it is extremely difficult to convince employees that this should be done.

NOTES

1. What is the character of ore mills?
2. Are respirators worn?
3. Is amalgamation and mercury distilling done?

SCHEDULE XVII — METAL FORMING

Cutlery Manufacturing N. O. C. 3112
File Mfg. 3117
Hardware N. O. C. 3146
Tool Manufacturing — Agricultural Construction etc. 3126
Tool Manufacturing N. O. C. Forged .. 3112
Tool Manufacturing N. O. C. Machining or Finishing 3114
Tool Manufacturing N. O. C. Not forged 3113

EXPOSURE

Silicosis — pneumonoconiosis — lead.

SILICOSIS

CAUSE

High speed wet grinding, using natural sandstone wheels, develops a dust-laden mist which, if continuously inhaled, can cause silicosis. It is not considered that there is a real silicosis hazard if this operation is not carried on, except where there may be sandblast operations. If these sandblast operations are present, they should be treated as in a foundry.

Inhalation of dust created by the use of emery and other artificial abrasive wheels can develop other forms of pneumonoconiosis or lung trouble. While this hazard is not considered to be unusually serious, it is definite, nevertheless, and many state laws frequently require exhaust hoods for grinding wheels.

CONTROL

It is difficult to provide exhaust ventilation for wet sandstone wheels, as so much area of the wheel has to be used for the actual grinding operation. In those cases where only a small segment of the wheel need be exposed for grinding, there is no reason why the wheel should not be provided with a hood. Where hoods cannot be provided, the following should be given definite consideration:

1. Wherever possible replace the sandstone wheels with special artificial wheels that have been designed for grinding tools and cutlery, and equip these wheels with exhaust hoods.
2. Machine grinders should be provided with exhaust hoods.
3. Respirators should be used wherever it is not possible to provide exhaust ventilation.

NOTES

The engineering reports should particularly emphasize the following points:

1. Are high-speed natural sandstone wheels used for wet grinding?
2. Are dry grinding operations provided with exhaust hoods?
3. Are respirators used where exhaust ventilation is not possible?

LEAD

CAUSE

Lead poisoning can develop from inhaling fumes from lead pots used in some types of heat treatment (cyanide poisoning is a distinct hazard in heat treatment where it is used, but this is in the nature of an extreme accident hazard). Lead pots may also be used for other purposes and should likewise be guarded.

CONTROL

All lead pots should be equipped with proper exhaust hoods, irrespective of the temperature of the molten lead, for the hazard is present even at low temperature.

NOTES

The following points should be particularly discussed in the engineering reports:

1. Is lead used in heat treating operations?
2. Are lead pots provided with adequate exhaust hoods?
3. What is the exposure to lead poisoning?

SCHEDULE XVII — METAL FORMING — FOUNDRIES

Car Wheel Manufacturing — Cast	3833
Cast Iron Pipe (Centrifugal)	3093
Cast Pipe (Sand Process)	3089
Heater and Radiator	3175
Iron — N. O. C.	3081
Ironware, Manufacturing — Enameled	3091
Malleable Iron	3086
Non-Ferrous Castings	3085
Steel Castings	3082
Stove Manufacturing	3169

EXPOSURE

Silicosis, other pneumoconiosis, lead poisoning, brass founder's ague, manganese poisoning, cadmium poisoning, and phosphorous poisoning.

One of the most difficult occupational disease problems in industry arises from foundry operations in which sand is used for molding and cleaning purposes. It is not only difficult to estimate the extent and severity of the hazard existing in foundries, but it is very difficult to devise practical means of control for the existing hazard. Therefore, in every instance where a foundry is being inspected and studied, it must be done so in the most thorough and accurate manner. It should be realized that the absence of visible dustiness does not mean that there is no hazard. It is perfectly possible to have fine dust in dangerous concentration and have it invisible. On the other hand, wherever there is visible dustiness in a foundry, it is fairly certain that you have a definite hazard.

SILICOSIS

CAUSES

Silicosis is developed when fine quartz or silica particles are inhaled over a period of time. These operations in a foundry that involves dust exposure are sand preparation, molding, core making, pouring, shaking out, and cleaning. These will be discussed in detail to show the various causes of dust in a foundry.

SAND PREPARATION

Sand preparation consists of the removal of foreign materials, sifting to proper size, tempering by the addition of moisture or binder, and blending with other materials to produce a sand having the proper qualities for molding use. There is considerable exposure in preparing sand that has already been used. This sand has been thoroughly dried out by the hot metal and is extremely dusty to handle. The ordinary procedure is to shovel the sand into a pile about a foot high and two or three feet wide, running back about 15 or 20 feet from the molder's station. This pile is wet down by throwing several buckets of water on it, only wetting down outside of the pile, then the very wet and the very dry sand are worked together by means of the sand cutter. In this manner, a very large amount of dust is generated. It would be better to moisten all of the sand a moderate amount before shovelling into the pile rather than soaking some of the sand and leaving the remainder in dry powdery form. The sand separation should be carried on either in an isolated section of the building or at night. A sand cutter should not be operated when there are other men working unless respirators are provided. The operator of the sand-cutter should wear a respirator of an approved type.

In inspecting a foundry, the method of sand preparation should be observed carefully and also it should be remembered that this work is generally carried on at night, or in some cases in the early morning, and that it would not be seen in an inspection made at regular hours. It is important that the inspector should see all of the operations that are carried out in the foundry.

MOLDING

Molding is the art of producing in sand by means of a pattern a cavity later filled with molten metal, which upon cooling gives a casting having the shape of the original pattern. If the molding is done by hand a shovel is used for filling the flask or container and the buck end or a hand rammer is used to press the sand. For larger castings, the sand may be added by means of a sand slinger, which is a very dusty process. The operator should wear a respirator, and note should be made as to how much the sand slinger contributes to the general dustiness. On certain types of work the exposure to the dust from the parting compounds may be quite high, and so it is very important that a non-silica parting compound should be insisted upon.

There is some exposure during the molding process to dust from the molding sand, as this is generally sifted into the mold, but generally this sand is sufficiently moist so that this exposure is comparatively negligible. There is little that can be done about the exposure to the molding sand, and so effort at dust control should be concentrated on more severe hazard which can be greatly minimized.

CORE MAKING

Core making is the process of making of sand, to which a binder has been added, the so-called sand cores, to be used in producing castings having hollow interior cavities or sections. They are made from damp sand in core boxes or in core machines and then transferred to baking ovens for hardening, pasted, fitted and supplied to the molders. Core makers are exposed to dry dust arising from the core board in the process of removing the baked cores from the ovens and in cleaning the boards. Except for the use of compressed air for cleaning the baked cores, or blowing the sand from the core making machine, there should be no appreciable hazard.

POURING

There is considerable dust and smoke present in a foundry while the metal is being poured. However, very little of this is silica, and the actual pouring operation does not contribute greatly to the occupational disease hazard. However, in many foundries the shake out work starts while the pouring is still in operation, and so the molders are for a short time exposed to the worst condition, that the workers on the shake out encounter. After the castings have been poured and sufficiently cooled, they are removed from the flasks by a process known as the shake out, which may range from the simple dumping of the castings by hand to the use of overhead cranes to support the flasks while the castings are being freed with bars used as battering rams. This is perhaps the dustiest work that men are exposed to in industry. Inasmuch as the dust that these men are exposed to contains a large amount of silica, and further that there is no simple means of minimizing this exposure, the need for accurate information concerning this process in a foundry is apparent. The best solution to this process is a central shake out where mechanical vibrators are used under an exhaust. Due to the expense, it is seldom that one finds this method used. The work should be done at night after the molders have left, so as to cut down the number of men exposed. The men engaged on the work should wear respirators and should be rotated with some other job so that their total exposure on this type of work will be under ten years.

CLEANING

The castings are cleaned of adhering sand by means of tumbling mills, sand blast cabinets, and blast barrels or sand blast tables. This work, while involving a serious exposure, is one that can be entirely controlled. These sand blast cabinets, barrels or tables should be exhausted and the dusty air discharged through a filter system to the outside air. Sand blasting should be done within an exhausted closed cabinet and the operator should be protected by a positive pressure helmet with air from a clean source. Steel shot makes a safer abrasive than sand from an occupational disease standpoint, although the same precaution should be used. It should be remembered that the dust encountered in the cleaning department is much higher in silica than in the dust encountered in any other part of the foundry, and

CU 30052

so the slightest amount of visible dust in this department should be reported.

CONTROL

1. Sand preparation should be carried on in an isolated section of the foundry building or at night.
2. The operator of the sand cutter should wear a respirator of the approved type.
3. The sand cutter should not be operated when there are other men working unless respirators are provided.
4. An effort should be made to have the sand wet uniformily instead of working some powder dry sand into very wet sand.
5. Men should not be kept on the sand preparation work, particularly operating the sand cutter for any length of time.
6. Shakers and riddles, should be totally inclosed and equipped with exhaust ventilation wherever possible.
7. Molding operations should be carried on the use of a silica free parting compound. This is practical in all except some malleable iron foundries.
8. Sandslinger operators should wear approved respirators.
9. Suction should be used for cleaning in the Core Room. Cores and Core boards should not be blown off with compressed air.
10. If possible the castings should not be dumped from the flasks until after the pouring is completed. This cuts down on the exposure experiences by the molders, while they are doing very hard physical labor.
11. Central shake outs where mechanical vibrators are used under an exhaust hood is the only complete solution to the exposure in the shake out period. However, in most foundries exposure during the shake out will have to be met by the men wearing respirators and doing the work at night, so that the minimum amount of men are exposed.
12. The most practical solution to this problem in some cases will be that of rotating the men who work on his job. The exposure should be kept as low as possible and most certainly should not run over 10 years.
13. All work in sand-blast cabinets should be done by a man protected by a positive pressure helmet with air from a clean source.
14. Steel shot should be substituted for sand wherever possible.
15. The steel shot should be sifted from time to time to remove the abrased particles of sand that accumulate from the castings.
16. The cleaning department should be isolated from the foundry proper.
17. Tumbling barrels should be enclosed and adequately exhausted.
18. All sand blast cabinets, barrels and tables should be exhausted.
19. All abrasive wheels used for snagging and the cleaning of castings should be exhausted.
20. The dusty air accumulated in the exhaust system should be discharged through a filter system to the outside air. If there is a chance of the dust getting back into the plant, the cyclone dust erector is not adequate.

NOTES

An occupational disease report on a foundry should emphasize the following information:

1. Number of sand blasters and type of protection.
2. Complete description of any other cleaning that is done by sand.
3. The number of stationary and swing grinders and whether or not they are exhausted.
4. The number of mechanical riddles and whether or not they are exhausted.
5. The number of sand slingers.
6. The description of the operations of the sand cutter.
7. Does the operator of the sand cutter wear a respirator?
8. How many men are in the foundry while the sand cutter is in operation.
9. Condition of the dust collection system.
   (a) Is the fan on the clean side of the filter or collector. What is the condition of the fan and are the blades in good condition?
   (b) Have all exhaust lines been checked to make sure that they discharge into the dust filter?
   (c) Examine the outlet of the dust filter to make sure that torn screens are not letting dust past.
10. Description of the rafters; are they cleaned periodically and is a vacuum-cleaner system used?
11. Description of the general housekeeping of the foundry.
12. Is the floor dirt or concrete?
13. Is a non-silica parting compound used?
14. Average age of men in the molding, shakeout, cleaning, core making and sand perforation?
15. The size of castings?

LEAD POISONING

CAUSES

Lead poisoning may be acquired when alloys containing lead are cast. At the temperature required to melt the alloy, some of the lead is volatilized and is carried into the air where it condenses to form extremely fine particles of lead or lead-oxide. The inhalation of these fine particles over a period of time will cause severe lead poisoning. There is also a hazard in the grinding of lead containing alloys and in the enameling of iron wear.

The following alloys contain sufficient lead to cause trouble:

Battery plates, antimonial lead, magnolia, car box metal, white metal, aluminum solder, marine babbitt sawdust. These alloys all contain over 50% lead. Hardware bronze, ship sail brass, some journal bearings, and some of the fusible alloys contain a considerable amount of lead. In the enameled ironware manufacture there is an exposure to lead poisoning from the inhalation of lead dust from the enamel use to finish the product.

CONTROL

In addition to the ordinary method of prevention of lead poisoning, such as the drinking of milk, careful personal hygiene, there is need of adequate washing facilities and proper rooms separate from the room in which the lead operations are carried on, the following practices should be recommended.

1. Melting pots should be equipped with adequate hoods and have artificial ventilation if the lead content in the metal is high.
2. Lead casting machines should have hoods over the point of operation.
3. Lead casters should be provided with approved lead dust respirators.

   These should be used in addition to exhaust ventilation and should not be regarded as a substitute.
4. Lead melting pots should be equipped whenever possible with some form of temperature regulation, in order to prevent overheating of the alloys.

   If the temperature is kept below 750 Fahrenheit, there will be little lead escaping through the air.
5. Spray booths should be equipped with adequate exhaust ventilation.
6. Polishing and inspecting operations at benches should be provided with bench exhaust hoods.
7. Wherever possible, enamel not having a lead base should be used.
8. In recommending a non-lead enamel care should be taken that the substitute recommended does not contain a large amount of silica or fluosilicate. Where alloys containing a considerable amount of lead are poured, it is advisable to use fairly small pots and to pour only a few molds at a time. This will show the alloy to be poured at a much lower temperature than when it is necessary to overheat the metal in order that the last of a series of molds can be poured at the right temperature.

BRASS FOUNDERS' AGUE

The shakes or ague is caused by exposure to the clouds of zinc oxide that escape from the crucibles and ladles during the pouring of brass. Brass founders and all workmen who are exposed to zinc vapors are subject to an illness resembling an intermittent fever of irregular types. The symptoms are nausea, exhaustion, pains in limbs, headache, chills, sometimes vomiting, often fever, and profuse sweating. Among brass founders the condition sometimes occurs after the first day in the plant when the man has been away for a couple of days.

POURING OF BRASS

The fumes in the molding room are caused by the melting and pouring of alloy. In the former operation the greater portion of the fumes escape up the furnace flue, but some may escape into the room because the hood is not large enough. The fumes rise rapidly and, unless a sufficient opening is provided there, they are disseminated throughout the room. The ladle carriers, especially the rear men on the bull ladles or crucibles, are more directly exposed than the other workers.

CONTROL

1. The hoods over the furnaces should be large enough to collect all the zinc fumes, especially when the furnaces are tilted in order to pour the alloy.
2. The stack from the hood should rise above the adjoining buildings, so that the fumes will not be blown back into the foundry through the open skylight.
3. An artificial ventilating system adequate for the rapid removal of the zinc fumes is the best method for eliminating the brass foundrymen's ague.
4. Windows, doors, and skylights do not completely and effectually remove the zinc fumes in many foundries because they are not placed in proper relation to the source of the fumes and because of the interference of cross-currents and insufficiency of draft.
5. There is no danger from fumes during the melting of the alloy in pit furnaces, as the fumes escape up the chimney.

MANGANESE POISONING

CAUSES

This may be caused by the fumes from heated manganese or from exposure to the dust in the grinding and polishing of manganese containing alloy. The symptoms are languor and sleepiness, a peculiar slapping gait, and uncontrollable laughter. It does not shorten life but the poisoned men are crippled for life. The following alloys contain an appreciable amount of manganese:

Manganese bronze — 5% manganese: Manganin — 4.15% manganese Magnetic alloy — 26% Manganese.

Due to its high boiling point, 1900° centigrade, there should be little hazard connected with its use in the non-ferrous alloys. However, in the manufacture of manganese steel, there have been several death cases where the manganese was melted instead of being added in solid form.

CONTROL

1. Grinding, polishing, and buffing of manganese containing alloy should be done on wheels equipped with an adequate exhaust system.
2. The alloy should be made up by adding the solid manganese and not melting it in an electric furnace.
3. If it is necessary to melt manganese in an electric furnace, it should be done under a forced draft and poured under an exhaust hood.

CADMIUM POISONING

CAUSES

The most common cause of cadmium poisoning is exposure to the fumes, from melted cadmium. It melts at 321.63°C. and the boiling point is 778.90°C., and so it is a very volatile material as well as a very poisonous one.

CADMIUM

It is used in certain low melting alloys for sprinklers, and it is sometimes handled as the pure metal in jobbing foundries. Fatalities may arise from one pouring of overheated cadmium.

CONTROL

Care should be taken to avoid heating the cadmium much over the melting point. It should be only poured in rooms having very excellent ventilation. It should not be melted in crucibles that are not adequately fitted. Men who have been poisoned by cadmium should not be allowed to pour. If brown fumes are coming from the crucible it should be covered and allowed to cool before pouring. It should only be handled by people who are familiar with its properties.

PHOSPHORUS POISONING

CAUSES

There is a possibility of phosphorus poisoning in the manufacture of phosphor bronze. Phosphorous causes what is known as phossy jaw. After exposure to phosphorous fumes for a considerable time the jaw-bone begins to rot. Fortunately, there is not much phosphorus contained in most alloys. It will run from a trace to as high as .80%. There has been a case reported of phosphor-bronze where the proportion of phosphorus in the bronze was only .76%.

CONTROL

There should be excellent artificial ventilation in those foundries where it is a practice to form phosphor-bronze. If possible the same workers should not be required to pour all of the bronze.

NOTE

An occupational disease report on a foundry should emphasize the following information:

The composition of any alloys that might be handled with particular attention being paid to lead, zinc, manganese, cadmium and phosphorus.

The temperature at which the metal is poured.

Are the fumes carried away by the ventilation either artificial or natural?

Are the grinding and buffing exhausted?

SCHEDULE XVII — METAL FORMING

Agate or Enamel Ware Manufacturing	3224
Auto Parts Manufacturing (Radiator)	3307
Can Manufacturing	3220
Fireproof Equipment (Furniture)	3076
Lamp Manufacturing N. O. C.	3223
Metal Goods, N. O. C.	3400
Metal Sign Manufacturing	3064
Soda Water Fountain and Apparatus Mfg.	4940
Stove Manufacturing	3169

EXPOSURE

Silicosis, Chromium poisoning, lead poisoning.

SILICOSIS

CAUSE

Silicosis can arise in the following manner:

1. By inhaling sand dust from one sandblast cleaning of sheet metal parts prior to enameling or painting. The sandblasting operation is not always isolated so that the exposure may be to all employees in the room. Cleaning of castings by sandblasting has already been discussed under "Foundries."

CONTROL

The exposure to dust can be minimized by the following:

1. Equip sandblast cabinets with adequate exhaust ventilation.
2. Provide positive pressure helmets for handwork sandblasting.
3. Provide respirators for those employees handling work from the sandblast cabinets.
4. Wherever it can be done, substitute metal grits for sand. This may not always be practical from a manufacturing standpoint.

NOTES

1. Are sandblasting operations carried on?
2. Are they separated from other operations?
3. Are the operations enclosed?
4. Is the enclosure provided with exhaust ventilation system?
5. Do sandblasters wear positive prsesure helmets?
6. Are respirators used by other employers who may be exposed to this dust?

7. Is vitreous enamel used to finish the product?
8. Is exhaust ventilation in connection with this finishing adequate?
9. Age and experience of men?

Silicosis can also come by inhaling quartz dust that may be produced by vitreous enamel spraying and finishing or brushing operations. Unless frit is used, the enamel does not usually contain silica.

LEAD

CAUSE

Lead poisoning can come from the inhalation of lead dust and fumes from the enamels and paints used to finish the product. The most common source of these fumes and dust is in spraying and brushing operations.

CONTROL

Intsallation of efficient ventilating system will tend to remove the dust. If the system is adequate, it will remove not only part of the lead hazard, but also the silica hazard discussed immediately above.

NOTES

The following points should be particularly emphasized.

1. Is lead oxide or other lead compounds used as base of the enamel or paint or is it used as a part of the frit?
2. Lead may also be used as a material in the manufacture of a product such as the manufacture of lead-sheathed caskets. If so, the precautions to put into effect should be similar to those described elsewhere under the lead hazards. Briefly, they are as follows:
   (a) All lead working operations should be provided with efficient exhaust ventilation.
   (b) Proper washing facilities should be supplied.
   (c) Respirators should be used on intermittent operations where ventilation is not practical.

CHROMIUM POISONING

EXPOSURE

Chromium poisoning and nickel rash can come from contact with chromium plating solution and inhalation or fumes that arise from plating tanks.

CONTROL

Methods of control are as previously described and, briefly, as follows:

1. Rubber gloves and rubber clothing should be used for mixing and wet operations.
2. Efficient exhaust ventilation system should be installed on plating and rinsing tanks.
3. Buffing wheels should be provided with an efficient exhaust ventilation system.
4. Adequate washing facilities should be supplied.

NOTES

In addition to other questions, the engineering report should particularly emphasize what, if anything has been done with regard to the above suggestions.

SCHEDULE XVII — METAL FORMING

Adding Machine manufacturing N. O. C. ... 3574
(From Schedule XVIII)
Electroplating 3372

EXPOSURE

Chromium poisoning and nickel rash can be caused by contact with chromium, salt solution, in mixing operations; by the fumes that arise from plating tanks; and the dust from buffing wheels.

There is also an accident hazard in connection with the use of potassium cyanide in gold plating or silver plating. However, this is more in the nature of an exceptional accident hazard rather than an occupational disease hazard.

CONTROL

In addition to the general precautions that should be followed where there is exposure to chromium poisoning, the following should be given definite attention:

1. Proper exhaust ventilation on all plating and rinsing tanks.
2. Use of rubber gloves and clothing to prevent contact of the skin with the chromium compound.
3. Adequate washing facilities should be supplied.
4. Buffing wheels should be provided with adequate exhaust.

NOTES

In addition to the other information that should be included on the inspection report, the following should be particularly explained in detail:

1. Are tanks and buffers provided with adequate exhaust ventilation?
2. What is the practice with regard to the use of rubber gloves and rubber clothing?
3. What are the washing facilities?
4. How much chromium or nickel plating is done?

SCHEDULE XVII — METAL FORMING

Battery Manufacturing (dry) 3642
Battery Manufacturing (storage) 3647

EXPOSURE

Almost every operation necessary to the manufacturing of lead batteries in which the lead or lead oxide is handled presents a definite and sometimes serious occupational disease problem. Lead poisoning can come from the handling of these materials or the inhalation of lead fumes and dust.

CONTROL

The following practices will do much to minimize the hazard of lead poisoning:

1. Wherever possible all lead operations should be provided with adequate and efficient fume or dust exhaust, preferably of the down-blast type. It may often be claimed that this is impractical, but it is a fact that there are many battery plants in which every point of operation has been provided with proper exhaust hoods. It is also true that reduction of hand operations and increased use of machine operations tends to decrease the hazard.
2. Adequate washing facilities should be provided.
3. Employees should be encouraged to have their working clothing laundered at least twice each week.
4. Some program of medical control should be considered, although the Corporation engineer should always discuss this subject with the Claim Department before making recommendations.
5. All new employees should be examined before employment in order to determine if there has been previous lead exposure.
6. Respirators may be used at times, but are not positive protection by any means.
7. It may at times be possible to have dust counts made in order to check the efficiency of the exhaust ventilation system.

NOTES

In addition to other general information submitted on the engineering report, each operation in these classifications should be carefully inspected with the following specific thoughts in mind:

1. Is the exhaust ventilation system in proper condition?
2. Is supervision of employees good?
3. What is the general condition of the cleanliness of the shop and the employees?
4. What is the medical control program?
5. Is special clothing worn by the employees?

SCHEDULE XVIII — MACHINE SHOPS FINE MACHINES AND INSTRUMENTS

Agricultural machinery manufacture	3507
Boot and Shoe Machinery Manufacturing	3558
Confectioners Machinery Manufacturing	3559
Electric Power and Transmission apparatus Mfg.	3643
Elevator Manufacturing	3042
Printing and bookbinding Machinery manufacturing	3548
Sewing Machinery Manufacturing	3561
Textile Machinery manufacture	3515
Valve manufacturing	3634

Included in the above list would also be any other machine shop or machinery building operations having iron or steel foundries incident to the general operations.

EXPOSURE

Silicosis.

CAUSE

Silicosis can come from inhalation of the sand dust in all the foundry operations and from the sandblast cleaning of castings.

CONTROL

The methods of minimizing dust hazards in these operations are similar to those described in the general foundry group. The engineering reports should go extensively into the extent of foundry operations and the exposure of dust that may come from other similar operations.

SCHEDULE XVIII — MACHINE SHOPS FINE MACHINES AND INSTRUMENTS

Clock Manufacturing	3382
Watch Manufacturing	3385

In addition to these two classifications, any other operations where instruments are manufactured should be included if luminous paint is used in any way.

EXPOSURE

Radio-active poisoning.

CAUSE

Paints are made luminous by including an infinitely small amount of radium salt or mezathorium salt. These substances are radio-active and give off emanations which are invisible and are to all intents and purposes without mass. These radio-active substances can cause slow destruction of body tissue, even though actual contact is not made with the pigment or paint. However, the hazard is not usually serious unless there is actual contact. Almost all of the cases of radium poisoning that have developed from watch dial operations were caused by the operations pointing their brushes on their own lips. This caused a poisoning which developed a necrosis of the jaw bone and resulted fatally in many cases. Almost any radio-active substance can bring about these conditions, although there may be some difference in the time required in the way of exposure before disability results.

CONTROL

The following practices will do much to minimize the hazards:

1. Methods should be developed for pointing

brushes and supervision should be directed to this point.

2. The paint should not be mixed. The liquid porton of the paint should be applied and the pigment dusted on elsewhere.
3. The quantities of paint used should be so controlled that not even the most minute quantity is wasted or spilled.
4. Drafts should be avoided in working rooms.
5. Stray emanations can be detected by placing dental x-ray film wrapped in blacked paper about the room.
6. Employees should follow habits of absolute cleanliness.
7. Medical examinations should be made of employees at regular intervals. Before any such recommendation is made to an assured, this subject should be discussed with the Claim Department.

●

SCHEDULE XVIII — MACHINE SHOPS, FINE MACHINES AND INSTRUMENTS

Ball and roller bearing manufacturing .	3638
Gear grinding or Manufacturing	3635
Machine Shops N. O. C.	3632
Plumbers' supplies Mfg. N. O. C.	3188

In addition to these, there should be included any other machine shop operations involving grinding machinery.

EXPOSURE

Pneumoconiosis other than silicosis, lead poisoning and dermatitis.

Forms of pneumoconiosis other than silicosis can result from very dusty machine grinding operations using emery wheels, carborundum wheels, etc.

CONTROL

Much depends upon how serious the dust hazard may be. If it is necessary to provide exhaust ventilation systems, this should be considered. This is of particular importance in those states where there are laws requiring grinding wheels to be provided with exhaust hoods. Such a state is Illinois.

NOTES

The following should be particularly emphasized in addition to the other general information submitted:

1. Are there any grinding operations producing excessive amounts of dust?
2. Are grinding machine operations provided with exhaust hoods in accordance with any laws that may require them?

LEAD POISONING

Lead poisoning can occur from inhaling lead fumes from the babbitt melting pots. There may also be lead melting pots for each treatment of tools in the tool department.

CONTROL

Installation of adequate exhaust ventilation systems to remove the fumes is the most satisfactory correction of the hazard.

NOTES

The following points should be emphasized in addition to other general conditions:

1. Are lead pots used?
2. Are they adequately guarded with exhaust hoods?
3. How many men are continuously exposed to lead fumes or dust?

DERMATITIS

CAUSE

Dermatitis can come by reason of constant contact with cutting oils that irritate the skin. Generally, there are three skin conditions that may develop:

1. Blackheads that are caused by lack of individual cleanliness.
2. Irritation and redness caused by harsh oils.
3. Boils that may spread to other workers by reason of contamination of the oil used by other workers.

CONTROL

The following practices are helpful in minimizing the hazards:

1. Use of good quality cutting oils. The parafine base oils often cause trouble.
2. Adequate washing facilities should be provided.
3. Cutting oils can be disinfected by addition of certain substances such as sulpho naphthol.
4. Sterilization of the oil wherever this can be practically done.

NOTES

In addition to other conditions, the engineering report should particularly emphasize what, if anything, is being done with regard to the conditions listed above.

●

SCHEDULE XX — VEHICLES

Auto or Aircraft engine Manufacturing	3805
Auto-manufacturing and assembling	3808
Auto junking (From Schedule 34)	3821
Auto bodies — Pleasure cars	3822
Auto Body Trucks	3823
Auto Body N. O. C. (From Schedule 20) ..	3824
Railroad Car Manufacturing	3831

EXPOSURE

Silicosis and lead poisoning.

CAUSE

The danger of silicosis from the operations in these classifications is principally limited to those having foundry operations. It is likewise possible to have other forms of pneumoconiosis in machine shop grinding operations and sandblasting wherever these are carried on.

The lead poisoning is principally confined to the open lead pots used in babbitting and tool hardening as in the machine shop group. Lead poisoning may also occur from the dust arising from breaking up old batteries during auto junking. The use of a respirator will improve this condition.

NOTES

The engineering reports should handle these hazards in the same way as described under "Foundry, Machine and Metal Goods Operations."

SCHEDULE XXI — STONE PRODUCTS

Abrasive Wheel Manufacturing	1748
Cement Manufacturing	1701
Concrete Products Manufacturing	4034
Emery Works	1747
Flint or spar grinding	1741
Mica goods. Manufacturing	1853
Plaster Mills	1703
Soapstone products	1745
Stone Cutting and Polishing N. O. C.	1803

EXPOSURE

Silicosis and other pneumoconiosis.

In cement manufacture, it is not usually considered that there is a silicosis hazard, where only lime dust is encountered, although there have been certain pneumoconiosis claims arise in this industry.

CAUSE

Silicosis can come from the inhalation of free silica particles in the dust that is created by the various operations. It should be borne in mind that the dust that is dangerous is invisible and, if the dustiness can be seen, it is almost certain that the invisible dust is present in dangerous concentration. Since silicosis is progressive, it can continue even without further exposure, so that interchange of labor does not act to retard the disease.

While most of these classifications carry a loading for silicosis, each one should be studied carefully in order to determine, if possible, the character of the materials used in order to get some idea of the free silica or quartz contents. As the proportions of these substances decrease, the hazard is presumably less. In limestone and marble, it is considered that there is no hazard.

CONTROL

The following practices can be followed which will tend to minimize the hazard:

1. Efficient exhaust ventilation systems should be installed to remove dust at the point of generation. Dust that is collected should be properly disposed of and not allowed to blow into the atmosphere.
2. Respirators should be used where exhaust ventilation systems are impractical.
3. All new employees should be carefully examined before employment. Do not ever recommend medical examinations of existing employees without the full knowledge and approval of the Claim Department.
4. Dust counts should be made wherever possible in order to check the efficiency and design of the dust removal equipment.

NOTES

The engineering reports should particularly emphasize the following:

1. What is the character of the rock or sand used with respect to the quartz contents?
2. How efficient are the exhaust systems?
3. What is the general dust control program?

SCHEDULE XXI — STONE PRODUCTS

Asbestos good Mfg. incl. spinning and weaving	1852

EXPOSURE

Asbestosis, benzol poisoning.

Asbestosis is a definite condition of pneumoconiosis, although it is not considered to be as serious as silicosis. While it results in a physical impairment of the lungs, it does not progress after exposure ceases, and tuberculosis as a contributing factor is not prevalent.

Asbestosis results from the inhalation of asbestos dust that may be generated during any of the operations in which asbestos is produced or manufactured. Some of the most pronounced hazards are in connection with textile operations, such as picking, carding, spinning, weaving, etc., although any operation making woven or molded products can create dust which may be harmful.

CONTROL

The following practices will tend to minimize the hazards:

1. Wet weaving.
2. Installation of high velocity exhaust ventilation systems at the point of operation.
3. Use of respirators on operations that cannot be practically exhausted.
4. Examinations of new employees before employment. Wherever it may be considered that existing employees are not in full normal health, they should be placed on jobs free from dust.

NOTES

The following points should be particularly emphasized in the engineering reports:

1. Are asbestos textile operations carried on?
2. Is weaving done wet or dry?
3. Are operations provided with exhaust ventilation systems?
4. Are respirators worn by employees doing incidental work such as loading paper beaters, cleaning exhaust collectors, etc.?
5. Have dust counts ever been taken in the plant? If so, what were the results?
6. What medical arrangements has assured put into effect?

BENZOL

CAUSE

Benzol poisoning can come from inhaling the fumes from impregnating tanks where benzol may be used as a thinner of the asphalt.

CONTROL

The principal ways in which the hazards can be minimized are as follows:

1. Substitute some other thinner for benzol.
2. Install efficient exhaust ventilation equipment.

SCHEDULE XXII — CLAY PRODUCTS

Brick and Clay products N. O. C.	4021
Electric — porcelain	4058
Potteries — china table ware	4053
Potteries, glazed or porcelain earthenware, Mfg. Hand or Cast	4061
Potteries — porcelain	4049
Potteries — Mfg. Porcelain Ware — Mechanical	4062
Potteries — Tile	4055
Terra Cotta	4054
Refractory products	4024

EXPOSURE

Silicosis—other forms of pneumoconiosis, and lead poisoning. The history of silicosis and lead poisoning in the ceramics industry is definite enough to require that the utmost care be used in making inspections in this classification. While there is definite variation in the hazards between the varous classifications, it is necessary that all be thoroughly examined.

The hazards in these industries depend largely on the process. For example, in the manufacture of water struck brick there is little hazard. In the manufacture of sand struck bricks, dry sand is showered on the molds to prevent sticking, and the preparation and application of this sand constitutes a serious hazard in some brick plants.

In the manufacture of fire brick, and refractories the finished brick have a considerable silica content and there is a hazard in this branch of the brick industry not present in the ordinary building brick manufacture. About 20% silica is used in sanitary wear, and the mixing of the ingredients as well as the dry finishing of the ware may cause silicosis.

SILICOSIS

CAUSE

Silicosis can result from the inhalation of silica dust. While there may be clay dusts which are free of silica, some types of claims may result if the dust is particularly heavy. The wet operations are generally considered to be non-hazardous.

The operations which tend to produce dusty conditions are dry grinding of clays, shales, scrap brick, and machine operations in connection with finishing, such as sanding of molds.

CONTROL

Many of the so-called dry grinding operations do not lend themselves too easily to control or removal. Sometimes they can be located in rooms with exhaust ventilation, but this is not always practical. Therefore, it may be that the use of respirators is the only alternative. Machine operations creating dust should be provided with exhaust ventilation to remove the dust at the point of origin. Green finishing of pottery will eliminate most of the potters' exposure.

NOTES

The following questions should be answered on the engineering report, in addition to the other information submitted:

1. What is the silica content of the various substances used?
2. What is the character and severity of dusty operations?
3. What is the exposure to dust with each operation in terms of number of employees?
4. What methods for controlling the dust have been installed?

LEAD

CAUSE

Lead poisoning can result from the inhalation of lead oxide dust in mixing and grinding of frits having a lead base. In some plants it is the process to add white lead to the frit which increases the hazard due to the solubility of the white lead. A particular hazard exists in using a pressure line to clean the dipped ware of the excess lead glaze after it is dried.

CONTROL

The following practices will tend to minimize the lead poisoning hazard where it may exist.

1. Employees in dry mixing department should wear respirators approved for use against lead dust.

2. Spraying and machine cleaning operations should be provided with an exhaust ventilation system to reduce the dust.
3. No lead should be added to the glaze after fritting.
4. Excess glaze should be removed under an exhaust hood.
5. No pressure lines or bellows should be used for cleaning ware.
6. Lockers should be installed in a room where there is no lead dust.
7. Bubblers should be provided for drinking water, and eating should be prohibited on the job.
8. Some kind of medical program should be in effect in regard to those employees exposed to a serious hazard of lead poisoning. This is a subject which should always be discussed with the Claim Department before any recommendation is made to the assured.

SCHEDULE XXIII — GLASS PRODUCTS

Cut glass manufacturing	4113
Glassware manufacturing N. O. C.	4114
Glass ware manufacturing	4111
Plate Glass manufacturing	4101
Sheet glass — rolled — not polished	4103
Window glass manufacturing	4102

EXPOSURE

Silicosis and lead poisoning. Silicosis can develop from inhaling the dust that can come from grinding and mixing of the glass melt. Very naturally the hazards are varied according to the quartz content of sand that is used, although other forms of pneumoconiosis can develop from inhaling glass dust and other ingredients of a mineral nature. In some instances, sandblasting operations will be found, and these can be a source of silicosis hazard.

CONTROL

The following practices will tend to minimize the silicosis hazard:

1. Employees working in dusty operations that are not provided with exhaust ventilation, and those employees doing loading and unloading of sand should wear respirators.
2. Exhaust ventilation equipment should be installed on grinding and dry-mixing operations.
3. Wet grinding of glass can minimize the dust hazard.

NOTES

The following points should be particularly emphasized on the engineering reports, in addition to the other general information:

1. What is the quartz content of the sand that is used?
2. What is the extent of exposure of employees to various operations where dust originates?
3. Are respirators worn by any employee?
4. What, if any, operations are provided with exhaust ventilation equipment?

LEAD

CAUSE

Lead poisoning can result from inhaling lead oxide dust in mixing operations, and may sometimes occur by reason of the dust from glass cutting operations. Lead is always a constituent of the melt in connection with the manufacture of cut glass, although it is not usually used in the manufacture of other types of glass.

The following practices will tend to minimize the hazard:

1. Employees who are handling lead oxide in mixing operations should wear respirators.
2. Exhaust ventilation systems to remove the dust should be installed on glass cutting wheels.
3. Some type of medical control program should be in effect, but, before any recommendation of this sort is ever made, it should be discussed with the claim department.

NOTES

The following points should be particularly emphasized upon the engineering reports. In addition to the other information submitted:

1. To what extent is lead used in the glass?
2. Are respirators worn by employes in dry mixing operations?
3. Are glass cutting wheels provided with exhaust ventilation?
4. What program of medical control is in effect?

SPECIAL NOTE

In the manufacture of so-called "Safety Glass" celluloid or similar transparent substances are used as the bending or safety medium between the layers of glass. Such substances, in storage or during the glass manufacturing processes, can present fire or explosion hazards. Whenever these conditions exist, a complete report must be submitted.

SCHEDULE XXIV — CHEMICAL

Chemical and Dye Stuff Rating Plan 4800-23
4860-83

EXPOSURE

Cases have occurred from the following substances used in the making of dyes and dye intermediate. Benzene. Toluene. Nitrobenzene. Nitrochlorbenzine. Aniline. Natraniline. Dimethyline, Diethylaniline, Aniline Hydrochloride, Paranitro Chloraniline. Nitrous Diethylaniline. Paranitro Toluene. Dinitro Toluene, Ortho Toluidine. Paratoluidine, Paranitro Toluidine. Ortho Nitro Toludine. Acetylparatoluidine. Benzyl Chloride. Chlorinated Toluene. Paranitro Aniline Paraphenylendiamine. Metaphenylenediamine. Benzanthrene. Quinoline. Pyridine. Nitric Acid and Nitrious Oxide. Methyl Alcohol and Phosgene. The handling of finished dyes and colors does not generally constitute an occupational disease hazard. As a general thing the farther the process is from the crude stage the lower the toxicity of the product. Metanil yellow, orange 11, Echtmarine blue, New blue, R. fuchin, methyl violet and methyl green are exceptions among the finished dyes, and there has been trouble reported in the handling of these materials.

CAUSE

The more common poisons in this group such as benzol, analine, nitrobenzol, may be absorbed by inhalation of the vapors or through the skin when the material has been spilled on the body. Chronic benzene poisoning causes a loss of red blood corpuscles, resulting in profound anemia: a loss of the elements and substances in the blood which are concerned in blood clotting resulting in hemorrhage, and loss of white blood cells and of the substances in the blood serum which are concerned in defending the body against the bacterial infection. Nitro Benzol and the Nitro compounds in general act as blood poisons in addition to a direct action on the central nervous system. The amido compounds such as aniline, may cause bladder tumors and cancer.

CONTROL

1. In case Benzol, Nitro Benzol, Aniline or Toluol is spilled on the clothes, the material that has been soaked with the poison should be immediately removed and the skin very thoroughly washed.
2. The vessels in which Benzol, Nitro Benzol, and Aniline are processed should not allow the escape of the vapors into the room where the operators are stationed.
3. In case it is necessary to operate the vessel at atmospheric pressure, it should be vented to the outside rather than to the room.
4. Ventilation should be provided to carry off the fumes in the handling or processing of the raw materials or intermediates.
5. The essential idea behind control methods in this field is the prevention of poisoning by assuring pure air, for the workers. The use of respirators or gas masks is not practical, and so the fumes must be removed at the point of generation.
6. Pipe lines and other apparatus should be kept carefully inspected for leakage.
7. Men should be provided with rubber gloves and rubber boots where there is exposure to skin absorption.
8. Provide adequate washing facilities including shower baths, so that in case of spillage a man may completely remove the traces of the poisoning.

NOTES

1. Are the intermediates manufactured on the premises?
2. Is there any nitration of benzol?
3. Is there any noticeable odor from the raw materials or products?
4. Is there any reduction of nitro benzol?
5. Describe the ventilation in detail.
6. What are the provisions for medical examination of workmen exposed to benzol, nitro benzol, and aniline? Discuss with Claim Department before recommending.

SCHEDULE XXIV — CHEMICAL

Airplane Manufacturing (From Schedule 20)	3830
Artificial Leather (From Schedule 10)	4492
Artificial Leather	4456
Lacquer Manufacturing	4439
Pyroxylin Composition Goods Mfg. (From Schedule 10)	4452
Pyroxylin Manufacturing	4440

EXPOSURE

Benzol poisoning.

CAUSE

Poisoning usually occurs by breathing benzol fumes. Acute poisoning occurs when large amounts of benzol are breathed suddenly. Smaller amounts breathed over a period of time cause chronic poison which weakens and thins the blood. Benzol is also a skin irritant. It is volatile and inflammable. Poisoning in these classifications can come from

1. Mixing operations where soluble cotton is mixed with benzol.
2. Drying operations.
3. Cleaning of finished goods.
4. Hand cementing operations.
5. Spreading operations where plastic is rolled or cloth is coated.

CONTROL

The control of the benzol hazard depends upon preventing the breathing of the fumes; the following practices tend to minimize the hazard:

1. If possible, substitute some other solvent for benzol.
2. Carefully inspect pipe lines and other apparatus containing benzol to detect and prevent leaks.

3. Have all mixing operations completely enclosed.
4. Avoid spilling of benzol.
5. Provide artificial ventilation of all operations.
6. Ventilate the workrooms by exhaust of the floor level.
7. Discuss with your Claim Department medical examination of workers exposed to benzol.

NOTES

1. Is benzol used in this plant? If so, in what quantities and how often?
2. Are there indications of benzol spillage?
3. Are all mixing or other operations properly enclosed or ventilated?
4. Is there other general ventilation?
5. Has assured arranged for regular and competent medical examination of workmen exposed to benzol?

SPECIAL NOTE

Fire or explosion hazards often exist in some of these classifications. Complete reports describing them should always be submitted when required.

SCHEDULE XXIV — CHEMICALS

Color grinding — Whiting Mfg.	5954
Lead Manufacturing (red and white)	4567
Paint Manufacturing	4558

EXPOSURE

Lead poisoning.

CAUSE

Lead poisoning can come from inhalation of lead dust from handling and mixing of ingredients. The hazard is particularly pronounced in connection with dry lead base colors and all lead pigment manufacturing. Grinding of lead in oil is a dirty operation, but not considered to be too serious.

CONTROL

The following practices will minimize the lead poisoning hazard:

1. Machinery used in dusty operations should be enclosed to prevent escape of dust.
2. Installation of mechanical means of handling material, such as mechanical conveyors, will tend to eliminate dust.
3. Exhaust ventilation systems should be installed where it is deemed necessary and practical.
4. Respirators should be worn by those workmen exposed to dust where there is no other way of controlling the dust.
5. Adequate washing facilities should be provided and supervision directed to this point.
6. Some type of medical control program should be in effect. Before any recommendation is ever made to an assured on this point, it should be thoroughly discussed with the Claim Department.

NOTES

The following points should be particularly emphasized in the engineering reports, in addition to the other information submitted:

1. What attempts are being made to control the lead dust?
2. Are approved respirators used?
3. Are proper washing facilities provided?
4. What, if any, medical control program is in effect?

SPECIAL NOTE

Particular attention is called to the possibility of a fire or explosion hazard in some of these classifications. Such conditions must be completely reported.

SCHEDULE XXIV — CHEMICALS

Candle Manufacturing	4710
Fertilizer Manufacturing	4583
Garbage works (From Schedule 33)	7590
Glue Manufacturing	4653
Rendering Works	4710
Soap and Soap Powder	4720

EXPOSURE

Dermatitis and erysipeloid — Possible pneumoconiosis.

CAUSE

Dermatitis may result from these operations chiefly by reason of lack of personal cleanliness on the part of the employees. Erysipeloid may be caused by punctured wounds from bones. In those cases where caustic is used in the manufacture of soap, dermatitis may result from chemical irritation.

In the manufacture of chemical fertilizers, it is often found that some operations are carried on in the presence of very high dust concentrations. The dust may contain but small proportions of free silica, but a general hazard may be present. All such conditions should be very carefully and accurately reported.

CONTROL

Proper washing facilities and general cleanliness will be the most effective preventative measures.

SCHEDULE XXIV — CHEMICALS

Asphalt Works — Grinding, Pulverizing, etc. 1463
Distillation — Wood 1472
Paste and mucilage manufacturing 4596
Polish and dressing manufacturing 4597
Tar and asphalt manufacturing 4741
Turpentine and resin manufacturing 0301
Wood preserving (From Schedule 25) 2960

EXPOSURE

Dermatitis and creosote poisoning. Dermatitis and skin irritation can result from continuous exposure to the different materials used and manufactured in these classifications.

Creosote is a substance that is hazardous and may bring about disability.

CONTROL

About the only practices that can be put into effect are as follows:

1. Avoid personal contact with these substances and, so far as possible, have operations designed to do this.
2. Adequate washing facilities should be supplied and used.

NOTES

The engineering reports should particularly emphasize the following:

1. Describe the chance of personal contact with the materials.
2. What methods have been employed to prevent this contact?
3. Have proper washing facilities been supplied?

SPECIAL NOTE

Particular attention is called to the possibility of a fire or explosion hazard in some of these classifications. Such conditions must be completely reported.

CHEMICALS

This would include almost all of the classifications in the chemical and dyestuff rating plan. There are many chemicals with occupational disease hazards, although most of the dangerous ones are poisonous and the poisoning is usually considered to be an accident and not an occupational disease in the true sense. Some of the more dangerous ones are benzol, methanol, arsenic, chlorine compounds of hydrocarbons, salt of mercury, phosphorus and chromates. All lead salts can be causes of occupational disease.

CONTROL

The methods of controlling the hazards are so numerous that they cannot be listed here. The inspection reports should list in detail what are the various chemicals used and the exact manner in which each is used: also a complete history of what, if any, trouble may have developed in the past from such use.

Particular attention is called to any fire or explosion hazards that may exist.

SCHEDULE XXV — MISCELLANEOUS MANUFACTURING

Dental Laboratories 4692
Taxidermists 9600

EXPOSURE

Mercury poisoning.

These two classifications have been included because of the rate loading with respect to mercury poisoning. Mercury may be used in the preparation of dental amalgams. If taxidermists do any carroting of fur, the mercury hazard can be present there.

Industrial mercury poisoning almost always occurs from breathing mercury vapor over a long period of time. Mercury can also be absorbed into the system through the skin.

CONTROL

The following practices will tend to minimize the hazard wherever it is found:

1. Good general ventilation of work room.
2. Remove mercury. vapor and dust at the point of origin by special local exhaust ventilation.
3. Floors and work room should be of cement or other non-absorbing material.
4. Care should be exercised to avoid spilling of mercury.
5. Proper washing facilities should be provided and employees encouraged to wash frequently.

SCHEDULE XXV — MISCELLANEOUS MFG.

Auto and body painting 9505
Painting (shop only) 9501

EXPOSURE

Silicosis, benzol and lead poisoning.

CAUSE

1. Silicosis can result from the dust that is created by sandblasting and sandpapering operations.
2. Lead poisoning can result from lead pigment used in paints or lacquers.
3. Benzol poisoning can result from exposure to benzol used as a lacquer thinner.

CONTROL

The following practices will tend to minimize the hazards:

1. Sandblast operations should be carried on within cabinets and the operator further pro-

tected by wearing a helmet. If the sandpapering operations create heavy dust, little else except the use of the wet method can be done.

2. Spray painting should be carried on in properly constructed spray booths provided with adequate ventilation.

NOTES

The following points should be particularly emphasized in the engineering report:

1. What types of paints or lacquers are used?
2. What are the methods of applying the paints or lacquers?
3. Describe the ventilation facilities in complete detail?

SPECIAL NOTE

Describe in detail any fire or explosion hazard that exists.

SCHEDULE XXVI — MISCELLANEOUS CONSTRUCTION

Welding 3364

EXPOSURE

Lead poisoning.

CAUSE

Lead poisoning can develop by inhalation of lead fumes that are developed during the process of lead burning or in welding operations.

NOTES

The engineering report should give complete information upon whether any lead burning is done and describe the methods of protection.

SCHEDULE XXVI — MISCELLANEOUS CONSTRUCTION

Road construction with rock excavation 5508
Shaft sinking 6252
Subway construction 6254
Tunneling 6251

In addition to the above classifications, it should be borne in mind that all contracting operations where hard rock drilling is carried on can present a silicosis hazard.

EXPOSURE

Silicosis.

CAUSE

Silicosis can result from inhaling the dust that is produced by high speed drills and jack hammers. Another source of dust is from the rock crushers.

CONTROL

The chief means of controlling the dust is to use the so-called Kelley trap dust exhaust. It has been shown that wet drilling is not sufficient.

NOTES

The engineering report should particularly emphasize the following points in addition to the general information submitted:

1. How much hard rock is being encountered?
2. Are Kelley traps used on drills?
3. Are rock crushers in use?
4. If so, how much is produced?

SCHEDULE XXVI — MISCELLANEOUS CONSTRUCTION

Pneumatic caisson (building foundations) .. 6253
Pneumatic caisson (tunnels) 6257

CAUSE

Caisson disease can develop on all jobs requiring the use of compressed air in the driving of tunnels or sinking of caissons where men are required to work under a pressure higher than atmospheric pressure. The disease is caused by the formation of nitrogen bubbles in the blood passages of the body and, as a rule, the nitrogen bubbles will come to rest in some joint of the body and cause extreme pain. The nitrogen, of course, comes from the air. It is a serious disability and often results fatally.

CONTROL

The only method of preventing the development of caisson disease is to require that each employee working under the pressure go through a slow and gradual decompression procedure before again being exposed to ordinary atmospheric pressure. It is necessary on all jobs that a decompression chamber be provided and that a doctor be in attendance. Practically all states in the Union have very strict laws with regard to this entire subject, and each contractor should comply with the laws in absolute detail.

NOTES

The engineering reports should explain completely the pressure under which the men are working and the specific methods that have been put into effect by the assured to control the disease.

SCHEDULE XXXVI — OPERATION AND MAINTENANCE

Cleaning and renovating outside of building 5469

EXPOSURE

Silicosis.

CAUSE

Silicosis can result from inhaling the dust from the sandblast that is used to clean the outside wall of buildings. The dust that is created is very heavy, and almost always has a high silica content.

CONTROL

The only real method of controlling the hazard is to provide the workers with positive pressure helmets. In most instances, it will be found that ordinary helmets are in use, but they are not in any way efficient and to all intents and purposes are next to useless.

NOTES

The engineering report should specifically describe the protection against dust that has been made available to those men doing this sandblasting operation.

SCHEDULE XXVII — ERECTION

It is not considered that there are any occupational disease hazards in connection with the classifications in this schedule. Should there be any future exceptions, they will be included.

SCHEDULE XXVIII — SHIPBUILDING

It is not considered that there are any occupational disease hazards in the classification in this schedule, excepting those that may come up by reason of incidental operations, such as foundries, machine shops, etc., and the hazards of these have been discussed under the division to which they particularly apply.

SCHEDULE XXIX — SHIP OPERATIONS

Occupational disease hazards can be disregarded in this schedule.

SCHEDULE XXX — STEVEDORING

Occupational disease hazards in stevedoring can be disregarded as a general rule. Any specific exceptions can be covered by instructions to that effect.

SCHEDULE XXXI—RAILROAD OPERATIONS

Except for construction and shop operations, occupational disease can be disregarded in this schedule. For construction and shop operations, the general rules that have been explained in these industries can be followed.

SCHEDULE XXXII — CARTAGE AND TRUCKING

Occupational disease can be disregarded except on special instructions.

SCHEDULE XXXIII — PUBLIC UTILITIES

With the exception of contracting operations, the occupational disease hazard can be disregarded. Contracting operations are explained elsewhere.

SCHEDULE XXXIV — COMMERCIAL ENTERPRISES

Occupational disease hazards can be disregarded in this schedule, except on definite notification.

SCHEDULE XXXV — CLERICAL AND PROFESSIONAL OPERATIONS

Occupational disease hazards can be disregarded in these classifications.

SCHEDULE XXXVII — MISCELLANEOUS

Occupational disease hazards can be disregarded in these classifications.