The Compensation Cost of Occupational Disease.

BY

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The economic principle that loss of earning power properly attributable to employment should be borne by the consumers of the products is now quite generally accepted. To apply it to the indemnification of disease requires a careful definition of the hazard, if equitable compensation is to be realized with a minimum of litigation. Questions of contributory negligence of employee, assumption of risk, proof of fault of employer, the fellow servant rule, etc., no longer of any considerable moment in the plan of industrial accident indemnification, will probably never seriously affect disease compensation; and it is to be hoped that the problem will not always be unduly complicated by the present very real and exceptional difficulty of distinguishing bona fide occupational diseases from those not actually "arising out of and in the course of" the employment.

Competent inspection and safety engineering may be depended upon to effectively supplement legislation in eradicating unnecessary hazards of disease as well as of accident in trade processes, and the experience of the employers' liability system has demonstrated that the unavoidable destruction of human earning capacity may best be accepted without quibble as properly the burden of the consumer, along with mechanical wear and tear, and applied to the price of the commodity.

Here is a fertile field for the business of insurance, which, once opened to the companies, will be entered with the usual zest and solicitation manifested in scores of other fields, few of which can be compared in importance with the indemnification—and conservation—of human health.

Occupational diseases are defined by Dr. W. Gilman Thompson in his recent book "The Occupational Diseases" as "maladies due to specific poisons, mechanical irritants, physical and mental strain, or faulty environment, resulting from specific conditions of labor." We shall understand "occupational disease" to exclude disease or

infection definitely resulting from accident—taking "accident" in the ordinary sense of the word.

All the statutes evidently contemplate the compensation of disease or infection resulting from accident, whether they so specify or not, but none now enacted in this country appear to intend that occupational disease, as we are taking it, shall be compensated. Experience shows, however, that those statutes using the expression "injury" without the defining phrase "by accident" or its equivalent, are susceptible of interpretation favoring occupational disease claims.

The states and territories having such statutes at the present time are California, Connecticut, Massachusetts, New Hampshire, Ohio, Texas, and West Virginia, with statutes making no reference to disease; and Iowa and Wyoming specifying the exclusion of disease except as it shall result from an *injury* incurred in the employment. Michigan also falls in the class of the seven first named, but it is a singular fact that though the Michigan law is almost identical with that of Massachusetts, the Supreme Court of Michigan has definitely declared against occupational disease compensation while the highest tribunal of Massachusetts takes the equally positive stand that disease if truly occupational and likely to arise from the employment is an injury and compensatable. In the law of the United States, also, reference is only to injury.

The statutes of Hawaii, Indiana, Maryland, Montana, Nebraska, New York (as re-enacted), Oklahoma, Pennsylvania, Vermont and Washington have in effect been rather more closely drawn to admit only such disease as results from accidental injury; and no more liberal interpretation seems likely of the compensation laws of Alaska, Arizona, Colorado, Illinois, Kansas, Louisiana, Maine, Minnesota, Nevada, New Jersey, Oregon, Rhode Island and Wisconsin, which specify accidental injury but make no reference to disease.

No stronger statute reference adverse to occupational disease compensation appears than in the laws of Washington and Montana: "The words injury or injured, as used in this act, refer only to an injury resulting from some fortuitous event as distinguished from the contraction of disease." Nebraska most clearly defines its position as follows: "The word 'accident' as used in this act shall . . . be construed to mean an unexpected or unforeseen event, happening suddenly and violently . . . and producing at the time

objective symptoms of an injury. The terms 'injury' and 'personal' injuries shall mean only violence to the physical structure of the body and such disease or infection as naturally results therefrom. The said terms shall in no case be construed to include occupational disease in any form, or any contagious or infectious disease contracted during the course of employment, or death due to natural causes but occurring while the workman is at work."

The simplest immediate solution approaching equity seems to be the plan that has been in operation in the United Kingdom for ten years, of specifying diseases which shall be deemed as occupational, and compensating them just as accidents are compensated, in accordance with the degree of impairment of earning capacity. The list, as it has been since 1908, except for cataract in glassworkers and telegraphist's cramp brought under the act in December of that year, and writer's cramp first compensated in 1913, is that shown in the second table of this paper. Until effect of occupation upon health has been very much more carefully studied jointly by physicians, engineers and statisticians, it is doubtful whether any practical plan can be devised of closely approaching equitable compensation of all occupational disease. The proposed supplement to the New Jersey act, though designed "to extend the application of the statute to such diseases as can reasonably be diagnosed as due to the occupation"—the first definite American step in this direction—is therefore wisely drawn to cover only specified diseases, fourteen in number, the list being manifestly patterned after the British list of twenty-five, with the notable omission of the mine diseases nystagmus (oscillation of the eye-ball), cellulitis (miner's "beat hand," "beat knee"), bursitis ("beat elbow") and inflammation of the wrist joint, and the addition of anilin poisoning and wood-alcohol poisoning.

The purpose of the present discussion, however, is rather to consider the problem of the compensation of all occupational disease.

For cost figures we are compelled to look to British experience, the only available cost data of any extent being those of the United Kingdom, which are here summarized in Table I from the annual reports of the British Board of Trade for the seven years 1908–1914. The most satisfactory American occupational disease statistics appear to be those gathered for Ohio in 1913–14 by the Ohio State Board of Health Survey* of Industrial Health-hazards and

*Reviewed in *Proceedings*, Vol. II, pages 139–142.

Occupational Diseases under the direction of Dr. E. R. Hayhurst. These furnish no direct basis of estimate of cost of occupational disease, but they have been found very useful as an index of American occupational diseases and as a gauge of their incidence in comparisons with other statistics. Reference has also been made to the results of other state investigations, to the United States Labor Bureau Bulletins, and to the authoritative works of Sir Thomas Oliver and Dr. W. Gilman Thompson; and I am permitted to quote from the results of a preliminary study made in subcommittee of the recent Joint Conference on Workmen's Compensation Rates in New York City.

Table I brings together the cost figures for seven years of British compensation of the diseases listed in Table II, and shows the numbers of cases by industries and the amounts paid throughout the seven years. Many cases run over into other years and in the cost compilations have been counted once for each year in which payments were made. The numbers as increased by these repetitions are stated in the columns which have been given the designation "Payment Years." The ratios of the numbers of payment years and actual amounts paid, to the corresponding accident compensation figures are indicated as percentages in adjoining columns.

In the cost comparisons that we shall make, the first assumption is that the ratios in this table, or in a corresponding table of total incurred expense, would have applied in any American state, on any benefit scale, had American statutes specified compensation for the twenty-five diseases on the British list, and had the incidence of those diseases (as compared with accident) and the numerical distribution of laborers among the industries been the same in both countries.

Mine diseases of the eye and skin, however, for which four-fifths of British disease compensation was paid, anthrax, contracted in the handling of hides and wool imported from oriental countries, and phosphorus poisoning in the match industry, apparently exist to only a very limited extent in America. An investigation in England and Wales showed that in mines where lamps giving one-quarter candle-power were used, two per cent. of the men had nystagmus, while only four-tenths of one per cent. showed symptoms where the lamps were of one-half candle-power. The disease was unknown or very rare among men who worked with open-flame lamps or candles, but was common among those using safety lamps

TABLE I.

DISEASE COMPENSATION, UNITED KINGDOM, 1908–1914 INCLUSIVE, AND COMPARISON WITH CORRESPONDING FIGURES FOR ACCIDENT COMPENSATION.
(Compiled from the published annual reports of the British Board of Trade.)

Industry.	Exposure.	Rel. Size Industry, %.	Fatal.				Non-fatal.					Total.				
	Years of Work.		Cases.	% of Acdt.	Amount Paid.	% of Acdt.	Cases.	Paym t Years.	% of Acdt.	Amount Paid.	% of Acdt.	Cases.	Paym't Years.	% of Acdt.	Amount Paid.	% of Acdt.
Shipping	1,737,822	3.5	—	—	£—	—	1	1	.00	£ 48	.01	1	1	.00	£ 48	.00
Factories	35,831,039	71.1	226	3.34	36,271	3.76	3,300	4,465	.37	92,119	1.38	3,526	4,691	.40	128,390	1.68
Cotton	4,090,795	8.1	—	—	—	—	17	20	.03	170	.04	17	20	.03	170	.04
Wool, worsted, shoddy	1,983,686	3.9	19	12.75	2,560	16.15	135	156	.76	1,526	1.14	154	175	.85	4,086	2.70
Other textiles	1,693,298	3.4	2	2.15	125	1.17	17	17	.09	110	.11	19	19	.10	235	.20
Wood	1,032,292	2.0	5	1.81	786	2.13	39	47	.13	1,507	.47	44	52	.14	2,293	.64
Metal extraction	2,846,987	5.7	36	3.20	5,811	3.38	491	669	.31	16,777	1.55	527	705	.32	22,588	1.81
Engine and ship bldg.	2,007,631	4.0	12	.99	1,722	.94	187	244	.14	5,495	.48	199	256	.14	7,217	.54
Other metal work	5,670,875	11.3	28	2.73	4,012	2.67	541	669	.26	12,778	1.01	569	697	.27	16,790	1.18
Paper and printing	2,220,565	4.4	7	4.29	1,045	5.15	110	124	.43	2,280	1.12	117	131	.45	3,325	1.49
China and earthenware	464,593	0.9	60	92.31	10,217	120.10	397	844	9.83	24,121	50.42	457	904	10.45	34,338	60.94
Miscellaneous	13,280,317	27.4	57	2.39	9,993	3.01	1,366	1,675	.51	27,355	1.44	1,423	1,732	.52	37,348	1.67
Docks	890,178	1.8	8	.60	1,169	.57	57	64	.06	1,354	.18	65	72	.07	2,523	.26
Mines	7,411,749	14.7	6	.06	956	.06	25,418	35,583	3.01	514,568	8.60	25,424	35,589	2.99	515,524	6.71
Quarries	611,583	1.2	1	.18	230	.31	12	15	.04	209	.09	13	16	.04	439	.14
Construction	720,245	1.4	2	.27	321	.35	30	47	.10	1,299	.37	32	49	.10	1,620	.36
Railways	3,177,272	6.3	10	.34	2,167	.50	97	140	.09	3,576	.45	107	150	.09	5,743	.46
Clerical staff	493,556	1.0	—	—	—	—	2	6	1.45	208	9.44	2	6	1.37	208	3.16
Other employees	2,683,716	5.3	10	.35	2,167	.50	95	134	.08	3,368	.42	105	144	.09	5,535	.45
Totals	50,379,888	100.0	253	.99	£41,114	1.03	28,915	40,315	1.46	£613,173	3.97	29,168	40,568	1.46	£654,287	3.36

TABLE II.

SEPARATE CASES OF INDUSTRIAL DISEASE FOR WHICH COMPENSATION WAS PAID—UNITED KINGDOM, 1908–1914 INCLUSIVE.

Disease.	Total.	Mines.	Quarries.	Railways.		Factories.											Docks.	Construction.	Shipping.
				Clerical.	Other.	Cotton.	Wool, Worsted, Shoddy.	Other Textiles.	Wood.	Metal Extraction.	Engine, Ship Building.	Other Metal Work.	Paper and Printing.	China and Earthenware.	Miscellaneous.				
Anthrax	233	—	—	—	—	1	111	15	—	—	1	2	—	1	62	40	—	—
Lead poisoning	2,674	15	2	—	95	3	5	3	42	498	187	533	101	448	697	21	23	1
Mercury poisoning	40	1	—	—	—	—	—	—	—	1	—	5	1	—	32	—	—	—
Phosphorus poisoning	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
Arsenic poisoning	46	21	—	—	—	—	—	—	—	2	1	1	3	—	18	—	—	—
Hookworm	37	37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Benzine poisoning	153	—	—	—	—	2	1	—	—	—	—	—	—	—	150	—	—	—
Carbon-bisulphid poisoning	5	—	—	—	—	—	—	—	—	1	1	—	—	—	3	—	—	—
Nitrous fume poisoning	22	11	—	—	1	1	—	—	—	—	—	—	—	—	9	—	—	—
Nickel carbonyl poisoning	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
African boxwood poisoning	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Chrome ulceration	206	1	—	—	—	8	12	—	—	—	—	1	5	—	179	—	—	—
Eczematous ulceration	253	11	—	—	—	2	23	—	1	3	6	19	7	4	177	—	—	—
Epitheliomatous cancer	63	3	—	—	—	—	2	1	—	—	—	1	—	1	52	3	—	—
Scrotal epithelioma	10	4	—	—	—	—	—	—	—	5	—	—	—	—	1	—	—	—
Nystagmus	9,901	9,898	1	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—
Glanders	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Compressed air illness	17	—	—	—	—	—	—	—	—	—	1	—	—	—	7	—	9	—
Subcutaneous cellulitis, hand	5,283	5,228	10	—	9	—	—	—	—	8	2	6	—	—	19	1	—	—
Subcutaneous cellulitis, knee	8,456	8,452	—	—	—	—	—	—	—	3	—	—	—	—	1	—	—	—
Acute bursitis, elbow	755	755	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Inflammation synovial lining of wrist joint and tendon sheaths	995	986	—	—	—	—	—	—	—	6	—	—	—	2	1	—	—	—
Cataract in glassworkers	11	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	—	—
Telegraphist's cramp	2	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Writer's cramp (1913, 1914)	2	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Total	29,168	25,424	13	2	105	17	154	19	44	527	199	569	117	457	1,423	65	32	1
Fatal	253	6	1	—	10	—	19	2	5	36	12	28	7	60	57	8	2	—
Non-fatal	28,915	25,418	12	2	95	17	135	17	39	491	187	541	110	397	1,366	57	30	1

which give only about one-fifth candle-power with their gauze clogged with coal dust and soot as it is in ordinary use. The prevalence of the disease in Britain and its absence in America is therefore probably to be accounted for in an effective—though perhaps not great—difference in illumination. British coal miners apparently work with little machine help—and 95 per cent. of British miners are coal miners. In America, machines are extensively used, a fact that doubtless has an important bearing on the low reported extent of cellulitis, etc., in this country. Of anthrax, Dr. Thompson says "at present the disease is so much of a rarity in the United States that it is a surprise to find that in eight states it is included in the list of the six reportable occupational diseases, but this is accounted for by the fact that the first American reporting laws were copied almost verbatim from the British." Dr. Hayhurst says of reported cases in Ohio, "A little investigation of these instances brought us to the conclusion that none were authentic." It seems therefore that the American incidence of anthrax and of the mine diseases other than nystagmus cannot be over one-quarter of that in the United Kingdom, and that five per cent, is an ample estimate of the relative incidence of nystagmus.

Aside from the "British mine diseases," the health-hazard by far predominating in both countries is lead poisoning. Referring to conditions in 1910–1911, Dr. Alice Hamilton states in U. S. Labor Bureau Bulletin No. 104 that sanitary regulation had so far reduced the lead hazard in British potteries, that there were in that country at that time, notwithstanding the higher wages and better living conditions in America, only one-fourth as many lead poisoning cases there as here among equal numbers of pottery workers. It is probably reasonable to assume correspondingly improved regulation of the lead hazard in the other British industries, and similar reduction as well of the poison hazards of arsenic, benzine, mercury, etc. On the other hand, by the time compensation for occupational disease may have become regularly prescribed by statute in this country, we may confidently expect that American safeguards against these hazards will have improved with experience and growth of sentiment, to the extent that but two American cases will occur instead of four, in the industrial exposure that results in one British case.

An exact division of cost between what may be termed the "American" and the "non-American" diseases in the British data

is impossible for the reason that the cost figures at hand are not given by diseases. It will be noted, however, from Table II, that in several industries lead poisoning constitutes all but a small part of the disease hazard; in others anthrax predominates; while the mine diseases are prominent only in mining. The figures themselves therefore—with proper allowance for outstanding payments—yield fair average cost values of several of the diseases. It can be shown that except in the smallest industries the completed cost of compensation of the disease claims incurred in any industry during the seven years reported may be expected to be approximately seven times the average sum paid annually in the last two or three years. The results of such estimates are given in the first cost column of Table III. The average cost of a lead-poisoning case comes out at about £50, and of an anthrax case, about £30. It is worth noting in passing that cases ascribed to lead in the china and earthenware industry are evidently quite generally rendered much more severe by accompanying affections, most likely respiratory, as they show an average cost twice the corresponding figure from other industries. Division of cost within the group of principal mine diseases was of necessity by judgment, guided by some statistical information as to relative duration and severity of these cases, and by actual cost figures in the meager experience from quarries.

The following relative cost factors were finally assumed as sufficient for the elimination of the part of the British diseases considered as non-American: lead, 3; pottery "lead," 6; nystagmus and compressed air, 4; anthrax, mercury, phosphorus, arsenic, benzine, carbon bisulphid, nitrous fumes, cancer, glanders, telegrapher's cramp and writer's cramp, 2; and the others, 1; and the result of the elimination is shown, by comparison of the immediate footings of the third and fourth columns of Table III, to cut down the ratio of disease cost to accident cost from 4.6 per cent. to a little over 1 per cent., the estimated total incurred accident cost of the seven years being £22,315,000 (seven times the average annual actual payments of the last three years). As the relative number of lead and other occupational poisonings is expected to be doubled under American conditions, the ratio becomes about 1.9 per cent. This figure assumes the same distribution of workers in both countries in the industries studied. The remaining columns of the table exhibit the calculation of the modification of the factor on the basis

TABLE III.

DISEASE COST BY INDUSTRIES AND COMPARISON WITH ACCIDENT COST.

Industry.	Ratio British Workers to Total in the Seven Industries.	British Disease Cost.		Approximate Distribution Massachusetts Workers in These Industries.	Relative Industrial Distribution Massachusetts to British.	Relative Disease Cost on Massachusetts Industrial Distribution.
		Estimated Complete Seven Years' Claims.	Non-American Diseases Eliminated.			
Shipping.....	3.5%	£ 48	£ 48	1.0%	0.29	£ 14
Factories.....						
Cotton.....	8.1	327	303	12.0	1.48	448
Wool, worsted shoddy....	3.9	6,000	2,400	14.5	3.72	8,928
Other textiles.	3.4	235	104	3.6	1.06	110
Wood.....	2.0	2,740	2,740	3.5	1.75	4,795
Metal extraction.....	5.7	25,100	24,970	0.9	0.16	3,995
Engine and ship bldg...	4.0	8,470	8,430	0.9	0.23	1,939
Other metal work.....	11.3	20,800	20,660	13.4	1.19	24,585
Paper and printing....	4.4	3,320	3,320	6.8	1.55	5,146
China and earthenware	0.9	49,100	49,000	0.2	0.22	10,780
Miscellaneous.	27.4	43,500	42,000	29.2	1.07	44,940
Docks.....	1.8	2,690	1,600	0.4	0.22	352
Mines.....	14.7	850,000	92,600	0.0	0.00	0
Quarries.....	1.2	439	103	0.2	0.17	18
Construction...	1.4	2,100	2,100	9.0	6.43	13,503
Railways.....						
Clerical staff .	1.0	340	340	0.0	0.00	0
Other employees....	5.3	8,160	7,970	4.4	0.83	6,615
Totals.....	100.0%	£1,023,369	£258,688	100.0%		£126,168
Doubled, except mine diseases:			425,000			252,000
Ratios disease to accident cost (estimated incurred accident cost, seven years, £22,315,000):		4.6%	1.9%			
Hence expect in America, for British industrial distribution:			1.9%			
for Massachusetts industrial distribution:						1.1%

of the distribution of industries and workers in Massachusetts, for which state we have data as to accident cost and distribution by classifications. In arriving at the ratio 1.1 per cent., no account has been taken of the fact that compressed air disease, blindness, loss of the use of members from disease as by paralysis from poisons, etc., regularly compensated under accident provision and reflected in "accident" premiums where disease coverage is not

statutory, would under joint accident and disease provision be accounted occupational diseases—and were so reported in the United Kingdom statistics from which we have derived our cost estimates. Adjustment for this fact would reduce the ratio to something below 1 per cent. The total cost of accidents in Massachusetts relative to payroll in the interval July 1, 1912 to September 30, 1913 was estimated at 0.39 of one per cent. 0.0035 of one per cent. of the payroll of the industries studied is therefore proposed as a fair estimate of the probable cost of compensation of the twenty-five British diseases in these industries in Massachusetts.

The distribution of the 1,204 positive cases and 211 tentative cases of occupational disease discovered by the Ohio Board of Health survey among 236,000 workers in that state may be taken as representative of "all occupational disease" in this country. Nearly all these cases apparently came under the personal observation of the investigators, that is, few of the individuals seem to have been disabled to the extent usually regarded as compensatable; and of course the numbers stated are of existing cases of all durations of standing—not of new cases to be expected annually. Applying a system of cost factors, with calcicosis (lime phthisis), compressed air illness, pneumonokoniosis (lung-dust-disease), and tuberculosis at 4, lead poisoning and occupational neurosis at 3, and the others at 2 or 1, and accumulating the products of "positive cases" by cost factors, first through the list of all the diseases, and then for those only which—by other names—would probably be recognized under the British statute, the relative cost of compensation of all occupational disease to that of the diseases specified in the British act is estimated as approximately 1.8 to 1.

Preliminary to the distribution of the total net cost over the industrial classifications in Massachusetts, quite accordant estimates of the relative seriousness of the disease hazards in all the classifications of the Manual were independently made on a scale from 1, no appreciable special disease hazard, to 5, the maximum hazard, by the Engineering and Inspection Divisions of the Massachusetts Employees Insurance Association and The Travelers Insurance Company. About five per cent. of the total payroll under compensation in Massachusetts fell in Class 2, and about two per cent. in Classes 3, 4 and 5. Of the ninety-odd classifications rated 3, 4 or 5, about half show payroll in Massachusetts. These were studied first, and the disease premiums for Class 2 were then esti-

mated by proper comparisons with those for Classes 3, 4 and 5.

The initial procedure was the careful consideration, with joint engineering and medical advice, of, first, the diseases to which the workmen under each of the classifications in the three more health-hazardous classes were industrially exposed, second, the severity, in "compensation measure," of the average case if contracted, and third, the probability of contraction of such a case. Statistics, though usually altogether inadequate, were fully considered where available, and in the end a fairly satisfactory idea of the relative cost of occupational disease per $100 payroll for the various classifications was arrived at.

To illustrate, a preliminary value of 13 cents per $100 payroll, as the total occupational disease cost for iron smelting, was obtained as follows:

Disease.	Cause.	Normal Case.				Prob. of Contraction, z.	Prob. Annual Cost per $100 Payroll, $100 \frac{kz}{52}$.
		Medical (W.W.).	Weeks Disability.	Ratio Fatal Cases.	* Av. Cost k (W.W.).		
Gas poisoning....	Carbon monoxid, metallic fumes.....	1	2	.03	6.3	.002	$.024
Digestion, cramps.	Overheating.....	1	3	.02	5.2	.002	.020
Eye.....	Heat, glare, fumes....	1	2	—	1.0	.0005	.001
Kidney.....	Fumes.....	1	3	.01	3.5	.0005	.007
Rheumatism.....	Temperature change...	1	6	—	3.7	.003	.021
Lungs, throat, etc.	Temperature, moisture, dust.....	1	8	.04	12.1	.002	.046
Heart, arteries...	Over-exertion.....	1	8	.03	10.3	.0005	.010
Skin.....	Heat, acid, abrasion...	1	2	—	1.0	.002	.004
(Preliminary estimated) pure premium, all occupational disease....							.13

By similar analysis, 9 cents was assigned to lime manufacture, 11 cents to finishing textiles—bleacheries, and so on through the list rated 3, 4 and 5. After extending the list through Class 2 by comparison, all the preliminary premiums were multiplied into the Massachusetts payrolls and the amounts totalled, with a result 0.007 of one per cent. of the aggregate payroll of the state, or twice the estimated cost of compensation of the twenty-five specified diseases in Massachusetts, and according to the other assumptions of

* Basis, present Massachusetts Act; average cost fatal case about 178 weeks' wages, and disability after two weeks compensated at rate of two-thirds wages.

TABLE IV.

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
0100, 1	Tree pruning, spraying, fumigating, etc.	3	4c	Potassium cyanid, prussic acid, arsenate of lead, vitriol.
1412	Gold refining (no ore reduction)	2	3	Sulphuric acid fumes, heat, mercury, lead, potassium cyanid.
1421, 3	Iron smelting	3	6	Carbon monoxid, fumes, heat, moisture, temperature change, fatigue, metal dust, clay dust, glare.
1466	Graphite mfg.	2	3	Dust, heat, temperature change.
1652	Lime mfg.	3	4	Lime dust, fumes, irritants of eyes and skin, carbon dioxid.
1700	Adamant plaster mfg.	2	3	Dust.
1704	Stone crushing	2	2	Dust.
1741	Emery crushing, grinding	2	3	Dust.
1743	Silica grinding	2	3	Dust.
1745	Soapstone mfg.	2	1	Dust.
1780	Emery, carborundum wheel mfg.	2	3	Dust, heat, temperature change.
2080	Stock yards	2	2	Infection.
2081	Slaughtermen	2	2	Infection.
2082	Packing houses	2	2	Heat, dampness, steam, solder.
2171	Cigar, cigarette mfg.—by hand	2	3	Dust, fatigue.
2175	Tobacco mfg.—snuff	2	2	Dust.
2260, 3	Wool combing, scouring, carbonizing	2	4	Dust, fumes, anthrax.
2410	Waterproofing cloth—rubber	3	3	Carbon disulphid, sulphur chlorid, benzine, antimony, lead, wood alcohol, naphtha, mercury.
2411	Waterproofing cloth—not rubber	2	1	Fumes.
2413	Textile dyeing, finishing, printing—new goods	2	3	Dyestuffs, potassium cyanid.
2414	Bleacheries	3	6	Chlorine, hypochlorites.
2430	Oil cloth mfg.	2	3	Fumes, lead, irritants.
2431	Linoleum, cork carpet mfg.	2	3	Dust, fumes, lead, irritants.
2440	Wool separation.	2	4	Dust, fumes, anthrax.

TABLE IV.—*Continued.*

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
2530	Hat mfg.—felt	5	9c	Mercury, fur dust, steam heat, shellac, wood alcohol, grease, carbon monoxid, emery, sandpaper, nitric acid, arsenic, dyestuffs.
2580–2	Laundries	2	2	Heat, dampness, fatigue, bleaching compounds.
2583	Dyeing, cleaning	2	3	Dyestuffs, benzine, ammonia.
2600	Fur mfg.-preparing skins	3	9	Lime, arsenic, mercury dyes, fur dust, infection, anthrax.
2610	Degreasing skins	2	4	Benzine, anthrax.
2620	Leather mfg.—enamel	2	4	Heat, anilins, amyl acetate fumes.
2621	Morocco dressing	2	4	Heat, fumes.
2622	Leather dressing (n.o.c.)	2	4	Heat, fumes, chrome, anilins.
2623	Tanning	3	7	Lime, lead, dust, naphtha, amyl acetate, chrome, ammonia, anthrax.
2624	Curriers	2	5	Dust, anthrax.
2940	Lead pencil mfg.	2	2	Dust.
2941	Crayon mfg.	2	3	Dust, pigments.
3083	Foundries (n.o.c.)	2	4	Heat, fumes, dust, glare, dampness.
3084	Foundries-bell	2	4	Heat, fumes, glare.
3085	Foundries-brass	3	6	Lead poisoning, fumes, heat, dampness, temperature change, dust.
3120–2	Razor, cutlery mfg.	2	4	Dust, lead, potassium cyanid.
3302	Bedstead mfg.—metal	3	7	Lead, dust, wood alcohol, benzine, amyl acetate.
3312, 3	Copper, zinc goods mfg. (no smelting, rolling)	2	4	Copper, arsenic, lead, antimony, zinc.
3331	Lead works—sheet, pipe, shot (no smelting)	4	20	Lead, arsenic, antimony.
3334	Tinfoil mfg.	2	4	Lead.
3335	Babbitt metal mfg.	2	7	Lead, heat.
3337	Galvanizing, tinning sheet metal	3	3	Acid fumes.
3360–3	Oxy-acetylene, electric cutting, welding	2	4	Actinic rays, cyanids.
3370, 2	Plating	2	3	Lead, mercury, acid, fumes, benzine, potassium cyanid.
3631	Machine shops—with foundry	2	4	(See foundries)
3640	Storage battery mfg. from lead plates	4	18	Lead, acid fumes.

TABLE IV.—*Continued.*

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
3641	Storage battery mfg. from iron, nickel plates	2	2c	Fumes.
3642	Dry battery mfg.	2	4	Dust, fumes, benzol, acids.
3683	Thermometer mfg.	3	8	Mercury.
3687	Photographic supplies mfg.	2	3	Mercury, cyanids, vanadium, potassium permanganate.
3688	Photographic films, dry plates	2	4	Mercury, cyanids, fumes, nitrocellulose.
4014	Potteries, earthenware			
4030, 1	mfg.—tiling, gas retorts, sewer pipes	4	18	Dust, heat, dampness, lead pigments, sulphur.
4052	Earthenware mfg.—household utensils, art objects	3	12	Dust, pigments.
4100, 10	Glass mfg.	2	5	Heat, light, lead, dust of glass, emery, sandpaper.
4111	Bottle mfg.—no machine blowing	2	6	Heat, light, blowing.
4113	Glass mfg.—cut	3	6	Lead, dust, hydrofluoric acid.
4131	Mirror mfg.—no glass mfg.	3	8	Mercury, acid fumes.
4133	Cathedral, art, stained glass mfg.	2	6	Fumes of turpentine, amyl acetate, wood alcohol, benzine, lead poisoning, chrome.
4150, 2, 3	Optical goods, eyeglass, glass eye mfg.	2	3	Dust, chrome.
4205	Pulp mfg.—sulphite	2	4	Lime, sulphuric acid, fumes, moisture, dyestuffs.
4278	Fly paper mfg. (no paper mfg.)	3	5	Formaldehyd, fumes.
4301	Wall paper mfg.—designing, printing, etc. (no paper mfg.)	3	15	Arsenic, acid fumes, chrome, anilins.
4350	Electrotyping	2	4	Lead, arsenic, dust, acids.
4360	Motion picture—film development	2	3	(See photography)
4400	Rubber reclaiming	2	4	Benzine, naphtha, gasoline, carbon disulphid.
4410 4432	Rubber goods mfg.	2	5	Carbon disulphid, sulphur chlorid, lead, naphtha, benzine, wood alcohol, mercury, acids.
4440	Celluloid mfg.	2	2	Nitrocellulose, dust, fumes.

TABLE IV.—*Continued.*

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
4500, 2	Baking powder, soda-bicarbonate mfg.	2	2c	Carbon dioxid.
4510	Acid mfg. (n.o.c.)	3	10	Fumes, hydrocyanic, hydrochloric, hydrofluoric, nitric, etc.
4511	Analytical chemists	2	4	Various chemicals.
4520	Alcohol, acetic acid mfg.	2	2	Fumes, lime.
4521	Ammonia mfg.	3	8	Fumes.
4523	Disinfectant mfg.	4	13	Chlorine, formaldehyd, sulphur, carbolic acid.
4524	Chemical mfg. (n.o.c.)	3	12	Ammonia, benzol, bromin, carbon bisulphid, chlorin, iodin, nitrous gases, carbolic acid, etc.
4527	Bleaching powder mfg.	4	15	Chlorin, lime.
4528	Creosote mfg.	2	4	Fumes.
4530	Camphor mfg.	2	3	Fumes.
4551	White lead mfg.	5	22	Lead.
4553	Anilin, alizarin mfg.	2	4	Wood alcohol, methyl bromid, methyl iodid, nitrous gases.
4554	Color mfg.—dry	2	4	Anilins, ammonia, sulphuretted hydrogen.
4557	Ink mfg.—printing	2	4	Pyrogallic acid, tannins.
4558	Paint mfg.—no lead mfg.	3	16	Lead, chrome, antimony, turpentine.
4560	Whiting mfg.	2	4	Dust.
4561	Varnish mfg.	2	4	Ammonia, wood alcohol, turpentine.
4580	Fertilizer mfg.	2	3	Bone dust, phosphates, nitric, nitrous, sulphuric, hydrochloric, hydrofluoric and other acids, benzine, infection.
4590–2	Blackings, polishes	2	2	Dust, fumes.
4601	Drug mfg.	2	4	Compounds, alkaloids, etc.
4602	Essential oils mfg.	2	4	Vapors.
4606	Perfumery, flavoring mfg.	2	4	Dimethyl sulphate, essential oils, nitro benzol.
4607	Pharmaceutists	2	4	Chemicals and drugs
4630	Aerated, mineral water mfg.	2	2	Carbon dioxid.
4633	Carbonic acid gas mfg.	3	10	Fumes.
4634	Oxygen, hydrogen mfg.	2	2	Carbon monoxid, chlorid of lime.
4651, 3	Glue, mucilage mfg.	2	2	Fumes, dust, infection.
4714	Soap powder mfg.	2	2	Chlorin, dust.
4740	Oil refining	2	4	Carbon bisulphid, fumes.
4741	Tar mfg. (no coke oven operation)	3	12	Phenol, fumes, sulphuric acid.

TABLE IV.—*Continued.*

Manual Classifications Code.	Process.	Occ. Dis. Hazard Rating.	Pure Prem. for Occ. Dis.	Industrial Health-Hazards.
4762	Cartridge mfg.	2	4c	Brass.
4763	Acetylene gas tank charging stations—operation	3	7	Fumes.
5461	Painting, decorating, exterior	2	9	Lead, turpentine, wood alcohol, benzine, naphtha.
5462	Glaziers (away from shop)	3	8	Lead.
5490	Painting, decorating, interior (away from shop)	3	14	Lead, dust from sandpapering, dampness, turpentine, wood alcohol, benzine, naphtha.
6250, 3	Caisson work	5	10	Compressed air, carbon dioxid.
6254	Subway tunneling	2	5	Carbon dioxid.
6300	Sewer bldg.	3	5	Carbon dioxid, devitalized air.
7206	Towel, etc. distributing	2	2	Infection.
7500	Gas works	2	3	Carbon monoxid, cyanids, sulphuretted hydrogen.
7585	Sewer cleaning	3	12	Carbon dioxid, sulphuretted hydrogen.
7590	Garbage works	2	2	Infection.
8100, 5	Hide, leather dealers	2	2	Infection.
8200	Paper stock, rag dealers	2	2	Infection.
8801	Hospital employees	2	2	Infection.
9210	Fumigation of bldgs.	3	6	Hydrocyanic acid, formaldehyd and potassium permanganate, sulphur.
9501	Painting, shop only	3	17	Lead, dust, fumes, dampness.
9502	Sign painting, lettering, interior	3	9	As compared with ordinary painting, less lead in paint; less turpentine, benzine, naphtha in paint; little sandpapering; gloves worn.
9504	Enamelling (no metal working)	4	15	Lead, dust, heat, arsenic.
9541	Sign painting, lettering, exterior	3	7	See sign painting, interior.
9600	Taxidermists	3	6	Arsenic, mercury.
9620	Undertakers	2	4	Formaldehyd.

this paper, just about the expected cost of compensation of all occupational disease in that state. The preliminary relative pure premiums have been cut in two, however, as presented in Table

IV, for the reason that with our present inadequate knowledge of the tuberculosis hazard, for example, as affecting office clerks, iron smelters, textile workers, etc., a flat charge of one per cent. of the average accident pure premium, or about 0.004 of one per cent. of the payroll, would perhaps better be levied in addition to the premium quoted in the table.

The results of this paper are proposed as applying not only in Massachusetts, but in any other American state. The premiums for classifications under which there was no issue in Massachusetts have not at the present time been assigned. These and others that may be required in any state may be estimated quite satisfactorily by comparison with the premiums given in the table to classifications known to have comparable disease hazards.

Compensation of all occupational disease will probably not become statutory for some time to come. The premiums in Table IV are submitted, therefore, as representing the more likely cost for those specified diseases which will probably first be written into the statutes.

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