Scand J Work Environ Health 1979;5(2):30-40

<https://doi.org/10.5271/sjweh.2680>

Issue date: 1979

Occupational hygiene survey of 99 small workplaces with special reference to occupational health services.

by [Heikkilä P](#), [Hietanen M](#), [Kakko K](#), [Yrjanheikki E](#), [Hassi J](#), [Tolonen M](#)

Key terms: [occupational health](#); [occupational health service](#); [occupational hygiene](#); [occupational hygiene survey](#); [small enterprise](#); [small workplace](#)

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/524090

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

Occupational hygiene survey of 99 small workplaces with special reference to occupational health services

by PIRJO HEIKKILÄ, M.Sc.,¹ MAILA HIETANEN, M.Sc.,¹ KAUNO KAKKO,² ERKKI YRJÄNHEIKKI, L.Sc.,² JUHANI HASSI, M.D.,² and MATTI TOLONEN, M.D.¹

HEIKKILÄ, P., HIETANEN, M., KAKKO, K., YRJÄNHEIKKI, E., HASSI, J. and TOLONEN, M. Occupational hygiene survey of 99 small workplaces with special reference to occupational health services. *Scand. j. work environ. & health* 5 (1979): suppl. 2, 30—40. In the survey of the need for occupational health services in 163 small firms, a specific survey by qualified occupational hygienists was considered necessary in 99 places of work (55%) employing 1,715 persons. Noise, lighting and thermal conditions, as well as exposure to chemical substances, were assessed and measured. The survey required 80 person-days. Noise was the main problem. Hearing tests were required for 480 workers (28%), four-fifths of whom were employed in industry. The worst sources of noise were machines and tools (e.g., lathes, vibrators, stone drills, and pneumatic tools). Insufficient lighting was observed in 43 workplaces, half of which were in industry and half in service establishments. The most common causes were dirty lamps or lamps out of order or the lack of supplementary lights for specific areas. Thermal conditions were satisfactory except in ten firms where, according to recommended criteria, the temperature and relative humidity were too low. Since the measurements were taken mainly during the winter, the results reflect the effect of the coldest weather on the work environment. Solvents were the most common chemical hazards. They were found in 38 places of work including shops manufacturing metal and wood products, service stations, automobile repair shops, and laundries. One hundred and twenty employees (9%) were exposed to solvents, some only temporarily. Periodic health examinations were required for 55 workers by reason of solvent exposure. Eighty-one employees were exposed to allergenic substances, mainly concrete workers and persons working with epoxy resins or flour dust. Forty-one workers handled substances listed as carcinogens. Most of them worked in metal shops or other plants in which oil mist was present. Paint sprays also contained carcinogenic agents. In planning a survey of a workplace with potential or known problems, the staff of the health center or the company itself is advised to contact the nearest regional institute of occupational health.

Key words: occupational health, occupational hygiene, small enterprises.

¹ Uusimaa Regional Institute of Occupational Health, Helsinki, Finland.

² Oulu Regional Institute of Occupational Health, Oulu, Finland.

Reprint requests to: Ms. Pirjo Heikkilä, Uusimaa Regional Institute of Occupational Health, Arinatie 3 A, SF-00370 Helsinki 37, Finland.

The primary purposes of the occupational hygiene phase of the present study (8) were the following: (a) to identify the physical and chemical hazards that may impair the health and well-being of workers in the small work establishments of the communities under study, (b) to deter-

mine, with the aid of insights gained through past experience, the quality and quantity of the existing hazards, (c) to classify the individual workers into various exposure categories on the basis of a health hazard rating, and (d) in the light of the results to study the need for occupational hygiene programs and their array in the occupational health practices of municipal health centers.

WORK ESTABLISHMENTS SURVEYED

The sample of workplaces within Tuusula and Oulainen was chosen from the available registers of the municipal labor inspectors. The occupational hygienists surveyed places of work where, from advance information, one would expect physical or

chemical stresses or both. The occupational hygiene survey included a total of 99 different work establishments (20 % of all workplaces in the two communities) — in Tuusula 48 workplaces (16 %) and in Oulainen 51 workplaces (26 %). In all they employed 1,715 workers (22 % of the total personnel of all the workplaces in the two communities) (table 1). Those workplaces surveyed in Tuusula employed 851 persons, and those in Oulainen 864 workers.

Out of the workplaces selected 59 % had less than 10 employees and 6 % employed more than 50 workers (table 2). One-third of the establishments had existed for less than 4 years, 22 % 5 to 9 years, 29 % 10 to 19 years and 15 % 20 years or more. [Construction work and foundries were excluded because of existing recent studies on their health hazards (1, 7, 9)].

Within various divisions of economic activity the survey covered between 25 and 100 % because of the selection criteria. In

Table 1. Surveyed work establishments according to their economic activity.

Economic activity ^a	Number of workplaces	Number of employees
Other mining	1	14
Manufacture of food, beverages and tobacco	5	109
Textile, wearing apparel and leather industries	3	117
Manufacture of wood and wood and cork products, except furniture	15	85
Manufacture of paper and paper products, printing and publishing	1	30
Manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products	11	355
Manufacture of nonmetallic mineral products, except products of petroleum and coal	4	85
Manufacture of fabricated metal products, machinery and equipment	20	434
Water works and supply	1	6
Other construction	1	21
Retail trade	13	104
Restaurants and hotels	3	62
Transport and storage	2	69
Communication	1	26
Financial institutions	1	11
Public administration and defense	3	93
Social and related community services	4	53
Recreational and cultural services	2	7
Personal and household services	8	34
Total	99	1,715

^a Ranked according to the Standard Industrial Classification (SIC)

industry the coverage was 57 %, in service 17 %, and in other branches of economic activity from 3 to 14 %. The hygienists' survey covered 19 % of the total work force but nearly half of the industrial workers of the areas concerned.

COLLECTION OF BACKGROUND DATA

Before the survey the employers were sent a questionnaire asking for information on the company, especially information on occupational hygiene in the workplace and awareness of aspects of occupational hygiene among the personnel, especially the employer. The questionnaire emphasized facts necessary for planning the hygienic survey, e.g., general information about the company, stresses already recognized by the employer, environmental measurements that had already been made, chemical substances used and handled by the company, and the type of ventilation system. Supplementary data were then gathered during the visits to the workplaces.

HAZARD EVALUATION

Qualified occupational hygienists evaluated every place of work on the basis of their visits to the workplace, their interviews with the personnel and employer (or his representative), and their measurements of physical and chemical hazards. An evaluation of a place of work included consideration of the following: (a) the quality and magnitude of the risk factors, (b) the duration and frequency of exposure, (c) the number of exposed workers, and (d) the protective measures already in effect in the workplace. If a relevant risk factor did not present itself during the visit, the occupational hygienists made an estimation of the degree of risk and decided whether additional measurements or another visit would be necessary. The needed data on physical and chemical factors were generally obtained with portable direct indicators, e.g., in the case of noise, or short-

term (grab) samples. In the reports sent later to the workplace additional measurements were recommended in selected cases.

Table 2. Distribution of workplaces according to number of personnel.

Personnel	Workplaces	
	N	%
≤ 4	30	30
5—9	29	29
10—49	34	35
≥ 50	6	6
Total	99	100

Table 3. Rating scale used for the classification of exposure to the different physical factors.

Factor	Score
Noise (equivalent noise level)	
< 70 dB	0
70—84 dB	0.2
85—99 dB	0.5
100—115 dB	0.8
> 115 dB	1
Illumination ^a	
< 0.5 × recommended value	0
0.1—0.5 × recommended value	0.2
> 0.1 × recommended value	0.5
Temperature and relative humidity ^b	
Within recommended temperature zone	0
Within satisfactory temperature zone	0.2
Within tolerable temperature zone and in the area below satisfactory	0.5
Within poor temperature zone	0.8
Within extremely poor temperature zone or unacceptable	1
Air velocity	
Light work	
< 0.15 m/s	0
0.15—0.25 m/s	0.2
0.3—0.45 m/s	0.8
> 1.0 m/s	1
Heavy work	
< 0.3 m/s	0
0.3—0.45 m/s	0.2
0.5—1.0 m/s	0.5
> 1.0 m/s	0.8

^a Recommended value refers to that proposed by the National Illumination Committee of Finland.

^b Workplace measurements compared to the guides published by the National Board of Labor Protection.

Physical factors

Noise was measured in the hearing zone of the workers in the areas where they performed their jobs. A sound level meter with an A filter was used, as well as the fast time standard (3).

The lighting survey was made with a lux gauge on the level at which the work was done or 0.8 m from the floor.

Temperature and air velocity were measured by a thermoanemometer, generally at the level of the worker's neck and ankles. The relative humidity of the air was measured by an aspiration psychrometer at a distance of about 1.2 m from the floor.

Radiation leakage from microwave ovens was measured with a load of 275 ml of pure water.

The survey included no measurements of other nonionizing radiation or vibration, but, if needed, measurements were recommended as a usual service of the local regional institute of occupational health.

Chemical substances

The following chemical agents were considered and measured by direct indicators: inorganic gases, inert and organic dusts, welding fumes and gases, and formaldehyde concentrations. The concentrations of the solvents, paint fumes, and toxic metals were calculated from samples collected with personal samplers in some cases and stationary samplers in others. The health risk of other chemical substances was estimated on the basis of experience only, since no suitable measuring method was available. If needed, additional measurements were recommended to aid the evaluation of exposure and the need for preventive measures.

HEALTH HAZARD SCORING

The work sites were classified into the categories of 0, 0.2, 0.5, 0.8 and 1 according to the exposure data (tables 3 and 4). The

number of subjects exposed in each category was also determined.

Physical factors

The following physical factors were measured: noise, vibration, illumination, ambient temperature and relative humidity, air velocity, nonionizing radiation (microwaves).

The occupational hygienists rated every work site with any exposure by comparing the measurements and observations to accepted standards or recommendations (table 3) (2, 3, 4, 5, 6).

In this report noise exposure refers to the noise coming to the ear expressed as the equivalent continuous noise level. The International Organization for Standardization (ISO) recommends a 40-h workweek as an assessment criterion for continuous exposure to noise. In this survey long-term monitoring or repeated samples were not possible. Instead measurements were made during the visits to the workplaces, and consequently the duration of exposure, the periodicity, and the effective time of exposure were clarified in the interviews with the employees or the employer or both.

Table 4. Rating scale used for the classification of exposure to the different chemical factors.

Concentration $\bar{x}^a$	I— VI ^b	VII ^c	VIII ^d	IX ^e	X ^f
TLV					
$0 \leq \bar{x} \leq 0.1$	0	0.2	0.5		
$0.1 \leq \bar{x} \leq 0.5$	0.2	0.5	0.8		
$0.5 \leq \bar{x} \leq 1.5$	0.5	0.8	1		
$1.0 \leq \bar{x} \leq 2$	0.8	1	1		
$2 \leq \bar{x}$	1	1	1		
Not prevalent				0	0
Prevalent				0.5	1

^a $\bar{x}$ = the measured concentration or computed total of combined concentrations (e.g., of various solvents).

^b I = inorganic gases; II = acids, bases and other irritating substances; III = solvent vapors; IV = inorganic dusts; V = organic dusts; VI = welding fumes and gases.

^c VII = toxic metals.

^d VIII = mineral dusts.

^e IX = allergenic substances.

^f X = carcinogenic substances.

In the assessment of noise exposure the principle of equal energy was applied; i.e., when the noise energy is doubled or 3 dB are added to the noise level measured, the result is half of the exposure time with the same health effect. This principle was not applied as such for impulsive noise, but instead 10 dB were added to the noise level measured. The scores 0.5, 0.8 and 1 indicated a noise level possibly leading to hearing damage.

The lighting conditions were rated on the basis of recommendations of the National Illumination Committee of Finland (4). Only the scores 0, 0.2 and 0.5 were used. Whenever the illumination exceeded half of the recommended value, the score 0 was used. We recommended that the illumination of a work site be improved when a recorded value was one-tenth or less of the recommendation.

Thermal conditions were evaluated partly on the basis of the general safety guide for machines (6) published by the National Board of Labor Protection and partly on the recommendations of the Institute of Occupational Health, Helsinki.

Chemical factors

Chemical agents were divided into 10 exposure groups, i.e., inorganic gases; acids,

bases and other irritants (also irritating dusts); solvents; inert dusts; organic dusts, including wood dust and paint fumes; toxic metals; mineral dusts (dusts containing silica, asbestos, and talc); welding fumes and gases; allergenic materials; and carcinogenic substances.

Except for allergenic and carcinogenic substances, the exposure was assessed from a comparison of the results for every agent with the respective threshold limit value (TLV) published by the Ministry of Social Affairs and Health (4). For organic dusts and oil fumes, for which TLVs have not as yet been established, 5 mg/m³ was used as the recommended TLV.

The score given to any single work site was determined by the criteria given in table 4. A work area where one or more allergenic substances were used was scored 0.5, and in the case of carcinogenic substances the score 1 was always used.

Whenever there were several chemical substances in the atmosphere, e.g., many solvents, the maximum acceptable joint concentration was calculated as follows:

$$\left(\frac{C_1}{E_1} + \frac{C_2}{E_2} + \dots + \frac{C_n}{E_n} \right) \leq 1,$$

where $C_1, C_2, \dots, C_n$ = the measured concentration and $E_1, E_2, \dots, E_n$ = the respective TLVs.

Table 5. Hygienic measurements made prior to this study in the companies surveyed.

Economic activity ^a	Noise	Thermal conditions	Illumination	Solvents	Dusts
Mining and quarrying	1				
Manufacturing	20	1	2	6	1
Electricity, gas and water	1				
Construction	1				1
Trade, restaurants and hotels	3				
Transport, storage and communication					
Financing, insurance, real estate and business services					
Community, social and personal services	1				
Total	27	1	2	6	2
Measurements made during the survey	79	75	74	26	36

^a Ranked according to the Standard Industrial Classification (SIC).

If in the same exposure area there were several substances belonging to different exposure groups, the number of exposed workers was recorded for every exposure group. For example, if a worker was exposed to a carcinogenic substance and to another material which was, say, allergenic, then that worker was recorded in both categories as exposed. Therefore the figures indicating various exposures may be greater than the actual number of workers exposed.

The duration of exposure was taken into account in the scoring procedure as follows: an exposure duration of less than 15 min was considered as momentary. If the daily exposure exceeded 15 min, the exposure was considered as long-time. Whenever momentary exposure occurred and there was no set ceiling value, the score was determined as one degree lower than the value indicated in table 4. Whenever exposure was prolonged, i.e., more than 15 min daily, and there was a TLV ceiling value, then the score was determined directly from table 4.

Formaldehyde, epoxide resins, flour dusts, cement, toluene-di-isocyanate, and tropical species of wood and other generally recognized allergenic substances were recorded as allergens. As carcinogenic substances were classified those materials mentioned in the decision of the Ministry of Social Affairs and Health (5), which lists substances giving rise to a risk of cancer.³

RESULTS

Previous hygienic measurements

Before this study quite a few hygienic measurements had been made in the enterprises surveyed (table 5). Half of the measurements had been carried out by labor inspectors. The Institute of Occupational Health had performed measurements in 13 companies, and the rest of the workplaces

themselves or the Technical Research Center of Finland had monitored the work environment.

Employers' assessment of risk factors

Employers of 40 places of work reported noise as a problem in advance, while we rated 63 workplaces as in need of noise control measures. Only five employers reported that illumination was a problem, but the survey revealed faults in 43 establishments.

In addition, vibration, solvents, and dusts were considered harmful much less frequently by the employers themselves than by the hygienists (table 6). On the contrary the employers of 36 places of work regarded thermal conditions as defective, while the survey revealed only 10.

Employers' need for occupational hygiene consultations

A need for the measurement of environmental factors was the most commonly reported in the industrial places of work (table 7). Noise monitoring was requested the most frequently, followed by those for solvent vapors and thermal conditions. Counseling was desired on, among other things, the use and selection of personal protective items and on noise control. Altogether one-third of the employers reported that they had no need for occupational hygiene services.

Observations, measurements and the need for preventive measures

The occupational hygiene survey required 80 person-days. Complementary and control visits were recommended for nearly 40 companies, but they are beyond the scope of this report.

In most of the 99 places of work surveyed, the occupational hygienists considered measurements of physical and chemical agents necessary (table 8). The most needed measurements were those of noise, illumination, and thermal conditions (70—80 % of the workplaces), as well as of solvents and dusts (20—30 % of the total).

³ The current list on carcinogenic substances (879/78), issued by the Ministry of Social Affairs and Health, does not include oil mist.

In addition, measurements of vibration would have been pertinent in 20 places of work, but they were not included in the survey methods. Furthermore, supplementary measurements were recommended for 25 establishments for microwave radiation, noise, solvent vapors, and mineral dusts. Still other measurements would be required in order to assess the effect of recommended control measures.

Protective and preventive measures were needed the most with respect to noise. In many cases the use of ear protectors was recommended as an immediate

preventive measure, i.e., until technical preventive measures could be instituted.

The noise control measures recommended for 35 establishments would require quite reasonable expenditures. In 28 other firms technical improvements would require rather large financial investments, or for the time-being the problems could hardly be solved technically at all. In these firms the only protective measure that was likely to be initiated was the use of ear protectors, e.g., in jobs like stone drilling, working hand machines, operating woodworking machines, pneumatic equip-

Table 6. Employers' assessments of existing hygienic hazards and need for preventive measures observed by the occupational hygienists.

Economic activity ^a	Noise	Vibration	Thermal conditions	Illumination	Dusts	Solvents
Mining and quarrying						
Manufacturing	36	5	21	1	28	14
Construction	1		2			1
Trade, restaurants and hotels	3		6	1		
Transport, storage and communication			1			1
Financing, insurance, real estate and business services			1			
Community, social and personal services	4	1	5	3	2	1
Total	40	6	35	5	30	17
Observed need for preventive measures	63	20	20	43	41	24

^a Ranked according to the Standard Industrial Classification (SIC).

Table 7. Employers' estimation of need for hygienic counseling or measurement services.

Economic activity ^a	Counseling needed	Measurements needed	No need
Mining and quarrying	1	1	
Manufacturing	16	13	21
Electricity, gas and water			
Construction			
Trade, restaurants and hotels			
Transport, storage and communication		1	1
Financing, insurance, real estate and business services			
Community, social and personal services		1	6
Total	17	16	28

^a Ranked according to the Standard Industrial Classification (SIC).

Table 8. Measurements made, and need for additional measurements and preventive measures, estimated by the occupational hygienists during the survey.

Exposure	Measurements made	Additional measurements needed	Preventive measures needed
<i>Physical factors</i>			
Noise	79	13	63
Vibration		20	20
Illumination	74	2	43
Thermal conditions	75	2	10
Air velocity	71	1	12
Microwave radiation	2	3	1
<i>Chemical factors</i>			
Inorganic gases	14	1	6
Acids, bases and other irritating substances	9		9
Solvent vapors	28	10	24
Inert dusts	4		1
Organic dusts	19	2	17
Welding fumes and gases	12	5	9
Toxic metals	5	6	10
Mineral dusts	2	9	6
Allergenic substances	5	1	5
Carcinogenic substances	4	2	10

Table 9. Number of subjects exposed to physical hazards according to the health hazard rating. The percentages have been calculated from the total number of personnel in all of the workplaces surveyed. (N = number of subjects)

Exposure	Rating								Total		Need for periodic health examinations	
	0.2		0.5		0.8		1		N	%	N	%
	N	%	N	%	N	%	N	%				
Noise	240	14	395	23	55	3	30	2	720	42	480	28
Vibration									70	4		
Illumination	285	17	47	3					332	19		
Thermal conditions	540	32	42	2					582	34		
Air velocity	78	5	23	1	3	< 1			104	6		
Microwave radiation									12	1		

ment, printing presses, etc. In workplaces like these 108 persons (8 %) were employed. Altogether 720 employees (5 %) were exposed to a noise level possibly hazardous to hearing, and 480 (28 %) should have an audiometric examination (table 9). About 80 % of these workers were employed by industrial establishments in which the noise sources were various machines and pneumatic equipment.

Better lighting was recommended in 43 workplaces, of which about half were industrial. The rest were service establish-

ments. The illumination was less than 50 % of the recommended value in the work areas of 332 workers (19 %). Generally, the lamps were dirty or not working. Quite often supplementary lighting was needed in addition to the general lighting (table 9).

Solvent vapors were the most common chemical hazards. They appeared in 38 workplaces, e.g., in workplaces manufacturing metal, wood, and cork products, in service stations and garages, and in dry cleaning establishments. The highest con-

centrations, nearly 10 times the TLV, were found during painting in the manufacture of wood products and in motor vehicle repair shops. In these operations tasks involving exposure were short and periodic and, in addition, the worker should normally have respiratory protective equipment.

A total of 120 persons (7 %) were exposed to solvent vapors, and 68 of these (4 %) to concentrations exceeding the "action level," i.e., 50 % of the TLV. Yet, most operations involved exposures of short duration only, and the work patterns were periodic. When the duration and degree of exposure were taken into consideration, it was concluded that 55 subjects (5 %) would need a periodic health examination because of the health risk involved (table 10). Their work conditions could be significantly improved by means of ventilation and local exhaust systems. Once the recommended measures were accomplished, the health examinations would no longer be needed.

Sixty-five employees (4 %) were exposed to welding fumes and gases, and 2 % of these to concentrations exceeding half the TLV. Some 36 subjects (2 %) were ex-

posed to toxic metals in machine shops during spray painting and welding. Most of them, 28 workers, were exposed to lead (in eight different firms), and 26 would need a periodic health examination if the air concentration would be the only criterion (table 7).

Mineral dusts occurred in 11 places of work, where 30 subjects (2 %) were potentially exposed to silica dust. These jobs included sandblasting, stone quarrying, and drilling, i.e., tasks for which one normally wears a respiratory protector. Exposure to talc occurred in one printing shop.

Eighty-one individuals handled known allergenic substances; 79 of them were employed in industrial workplaces where they, among other things, were exposed to cement, epoxy resins, formaldehyde, and flour dusts. The exposure could have been avoided in many cases if the skin of the workers had been properly protected.

Exposure to carcinogenic substances was observed for 41 subjects, out of which 27 were exposed to oil mists in basic metal industries and concrete foundries. In addition hexavalent chromium occurred in paint fumes.

Table 10. Number of subjects exposed to chemical hazards according to the health hazard rating. The percentages have been calculated from the total number of personnel in all of the workplaces surveyed. (N = number of subjects)

Exposure	Rating								Total		Need for periodic health exami- nations	
	0.2		0.5		0.8		1					
	N	%	N	%	N	%	N	%	N	%	N	%
Inorganic gases	41	2	5	< 1					46	3		
Acids, bases and other irritating substances	28	2	9	< 1					37	3		
Solvent vapors	52	3	44	3	22	1	2	< 1	120	7	55	3
Inert dusts	47	3	7	< 1	1	< 1			55	3	5	< 1
Organic dusts	83	5	22	1	8	< 1	7	< 1	120	7	17	1
Welding fumes and gases	39	2	19	1	7	< 1			65	4		
Toxic metals	10	< 1	11	< 1	7	< 1	8	< 1	36	2	26	2
Mineral dusts			22	1	11	< 1	18	1	51	3	51	3
Allergenic substances			81	5					81	5		
Carcinogenic substances							41	2	41	2		

The most health-important exposures occurred in industrial establishments, motor vehicle garages, and service stations. These included noise (which occurred in 64 % of the places of work surveyed), vibration (21 %), solvent vapors (24 %), and toxic dusts. In addition illumination and thermal conditions were defective or unsatisfactory in several places.

Periodic health examinations were needed mostly because of exposure to noise (480 workers, i.e., 28 %), solvent vapors (55 workers, i.e., 3 %), and toxic dusts (77 workers, i.e., 5 %).

Most of the noted failures could be corrected or removed at a reasonable cost.

RECOMMENDED CONTROL MEASURES

Table 8 indicates the need for proper control measures with respect to occupational hygiene. The suggestions made by our research team included structural and other technical changes in the work environment, as well as the use of personal protective equipment.

Noise control was recommended in 63 % of the companies. Use of hearing protectors, either ear muffs or plugs, was advised as the most urgent measure. The suggestions were based on the following general principles: (a) checking and repairing the condition of the machine or equipment, e.g., replacement of worn-out bearings, (b) transfer of work site away from a noise source, (c) isolation of noise source, building-in the motor, installation of dividing walls, etc., and (d) use of absorbing materials. The specific approach would depend on the situation, and many other factors.

Amendment of the lighting systems was suggested for 43 % of the firms, particularly in industrial enterprises. For instance fluorescent tubes were recommended instead of usual lamps and the acquisition of supplementary lights were advised for certain work sites.

Recommendations for the promotion of the thermal environment were given to 20 firms. Mostly the general ambient temperature needed to be raised and the direction of the air jet stream distributed so as not to cause a draft.

Air contaminants needed to be reduced by engineering controls in nearly all the work sites measured. Gloves and protective clothing should have been used in the handling of acids, bases and other skin irritant substances. The concentration of dusts and solvent vapors could have been lowered in the first place by the installation of local exhausts. Ventilation was insufficient in most paint shops. Adequate space was not often available for the drying of newly painted products.

The installation of local exhaust ventilation was recommended at welding, grinding and painting work sites. Half of the welding sites were equipped with a local exhaust, but it was rarely used because of the welder's movements in the area. Machines generally had proper local exhaust systems.

Respiratory tract protectors should have been used in nearly all spray-painting shops.

OCCUPATIONAL HYGIENE SERVICES SUPPLIED BY MUNICIPAL HEALTH CENTERS

The occupational health services of any firm should begin with a general survey of the work conditions. In this context special attention must be paid to occupational hygiene. The health personnel should become alert to the prevalent physical and chemical (as well as possible biological) health hazards. During these preliminary visits environmental measurements are not necessarily needed, particularly if the occupational health personnel survey the workplace alone without an expert in occupational hygiene. They should rather consult an expert who is also able to perform the measurements required, interpret the results, and recommend control measures.

If the health center has, at its disposal, adequate equipment, including sound level meters, light meters, air velocity meters and thermal measuring equipment, and a person (e.g., a municipal labor inspector) qualified in occupational hygiene, that person may be consulted for the evaluation and for eventual measurements of the

work environment. For problems outside the scope of these instruments, or when an investigation is likely to be difficult, preferably the local regional institute of occupational health should be consulted. Permanent posts for occupational hygienists should not be established in municipal health centers since the need for continuous or recurrent environmental monitoring in small firms is rather small; besides, occupational hygiene knowledge and all required services can be provided without any difficulty by the network of regional institutes of occupational health that covers the whole country. Extensive training in occupational hygiene for physicians and occupational health nurses also seems impractical because the number of persons with experience and knowledge in occupational hygiene is not a matter for concern in Finland.

This study and advance data from companies and businesses prior to their being visited by occupational health practitioners allow an a priori estimation of what kind of environmental problems are to be expected in the small workplaces within a health center area. The surveys of problem work establishments should be planned jointly with the regional institute of occupational health.

At the health center level the need for environmental hygiene evaluation and measurements is greatest during the establishment of occupational health services (the survey and consulting phase). Once the problems have been recognized at a place of work, corrective measures and possible control measurements should follow. Repeated monitoring is seldom required even at the hazardous places of work. Expectedly, the need for occupational hygiene consultations from outside the firm decreases once the risks have been identified and corrective measures have been planned and implemented. Problems associated with changes in production or the establishment of new places of work often require the consultation of an expert.

In short, the occupational health staff of a health center should survey the firms they serve generally and assist with the identification of environmental problems and help locate the appropriate company

personnel for solutions. In carrying out this function the occupational health physician and the occupational health nurse is advised to draw on the regional institutes of occupational health.

REFERENCES

1. AHONEN, K., ENGSTRÖM, B. and LEHTINEN, P. U. *Rakennustyökarttoitus, työhygieniä* (Työolosuhteet no. 7) [Construction work survey, occupational hygiene (Work conditions no. 7)]. Institute of Occupational Health, Helsinki 1977. 73 p. + appendices.
2. FINNISH ILLUMINATING ENGINEERING SOCIETY. *Valaistussuosituksset: Luksitalukko, häikäisyindeksit* (Suomen Valoteknillisen Seuran julkaisu no. 2-1971) [Illumination standards: Recommended illumination, I.E.S. code clare index (Finnish Illuminating Engineering Society publication no. 2-1971)]. Helsinki 1974. 27 p.
3. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. *Assessment of occupational noise exposure for hearing conservation purposes* (International standard ISO 1999). Geneva 1975. 6 p.
4. MINISTRY OF SOCIAL AFFAIRS AND HEALTH. *Työpaikan ilman epäpuhtauksien enimmäispitoisuudet* (Teknilliset turvallisuuohjeet no. 13) [Threshold limit values of airborne contaminants (Technical safety guide no. 11)]. Helsinki 1972. 29 p.
5. MINISTRY OF SOCIAL AFFAIRS AND HEALTH. *Sosiaali- ja terveysministeriön päätös syöpäsairauden vaaraa aiheuttavista aineista* (174/77) [Decision of the Ministry of Social Affairs and Health on substances giving rise to a risk of cancer]. Helsinki 1977. 2 p.
6. NATIONAL BOARD OF LABOR PROTECTION. *Koneet, välineet ja tekniset laitteet (yleiset koneohjeet)* (Turvallisuusmääräykset ja -ohjeet no. 1) [Machines, tools and technical equipment (General safety guide for machines) (Safety regulations and guides no. 1)]. Tampere 1976. 56 p.
7. SILTANEN, E., KOPONEN, M., KOKKO, A., ENGSTRÖM, B. and REPONEN, J. *Valimopölyt* (Työterveyslaitoksen tutkimuksia no. 108) [Foundry dusts (Research reports of the Institute of Occupational Health no. 108)]. Institute of Occupational Health, Helsinki 1975. 86 p. + appendices.
8. TOLONEN, M. Municipal occupational health services for small workplaces: Background and general methodology of the study. *Scand. j. work environ. & health* 5 (1979): suppl. 2, 1-11.
9. VIRTAMO, M., TOSSAVAINEN, A. and RUISHALME, J. *Valimoaineet* (Työterveyslaitoksen tutkimuksia no. 109). [Foundry chemicals (Research reports of the Institute of Occupational Health no. 109)]. Institute of Occupational Health, Helsinki 1975. 109 p. + appendices.