The Role of Work Environment Control for the Prevention of Occupational Diseases in Japan, from the viewpoint of the experiences of Japan
Revised in August 2007

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1. Occurrence of occupational diseases in Japan in recent decades

The occurrence of occupational diseases in Japan fell from 18,000 per year in the late 1970s to an average of 13-14,000 in the 1980s. This number dropped further to 7,609 in 2004. Since then the figure has increased again from 8,226 in 2005 to 8,369 in 2006, respectively. (see Fig. 1 ; Source: *Survey of Occupational diseases* (Ministry of Health, Labour and Welfare)

Fig. 1 Transition of number of workers suffering from occupational diseases (accompanying absence of 4 days or more), by year

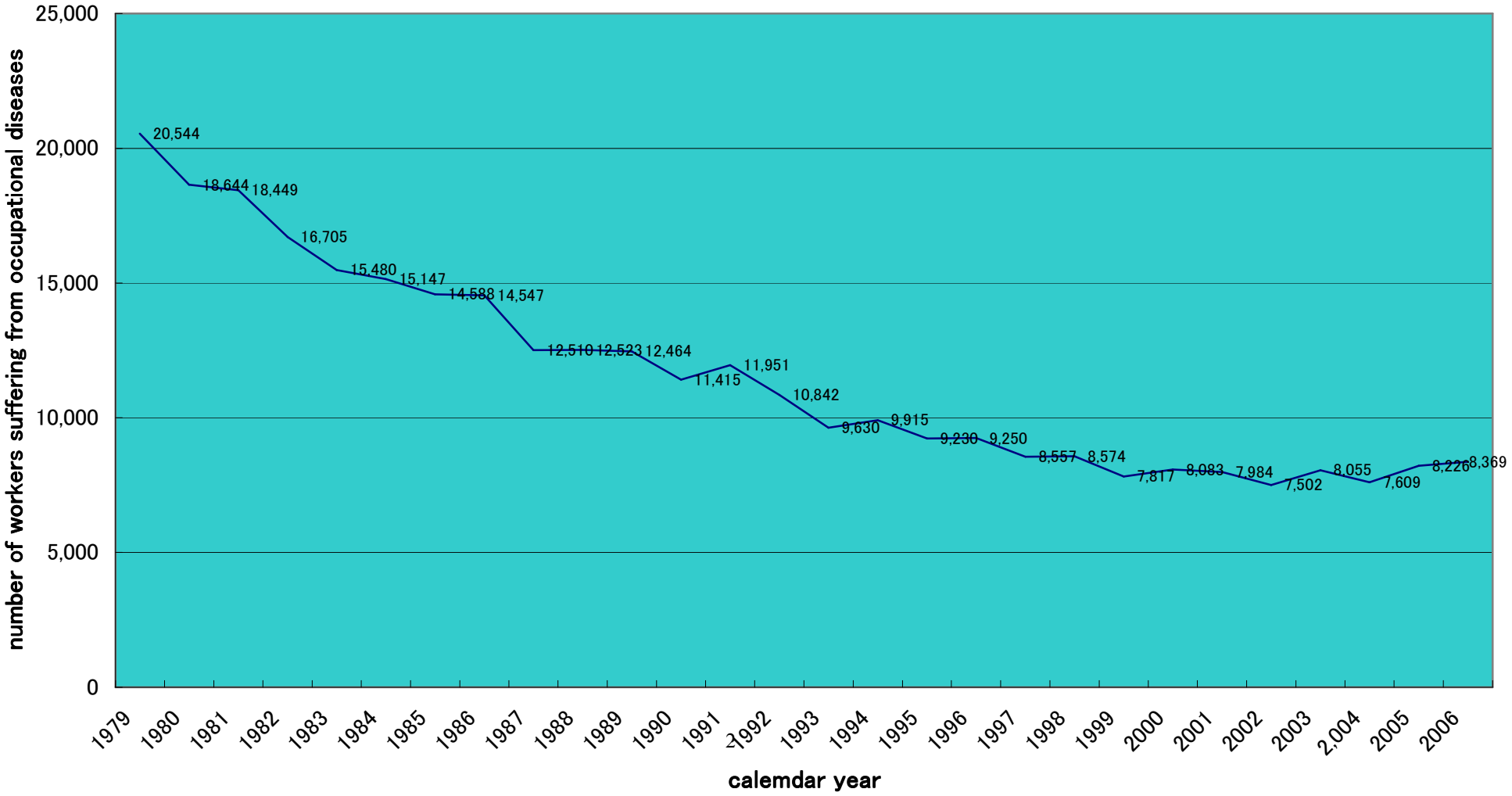
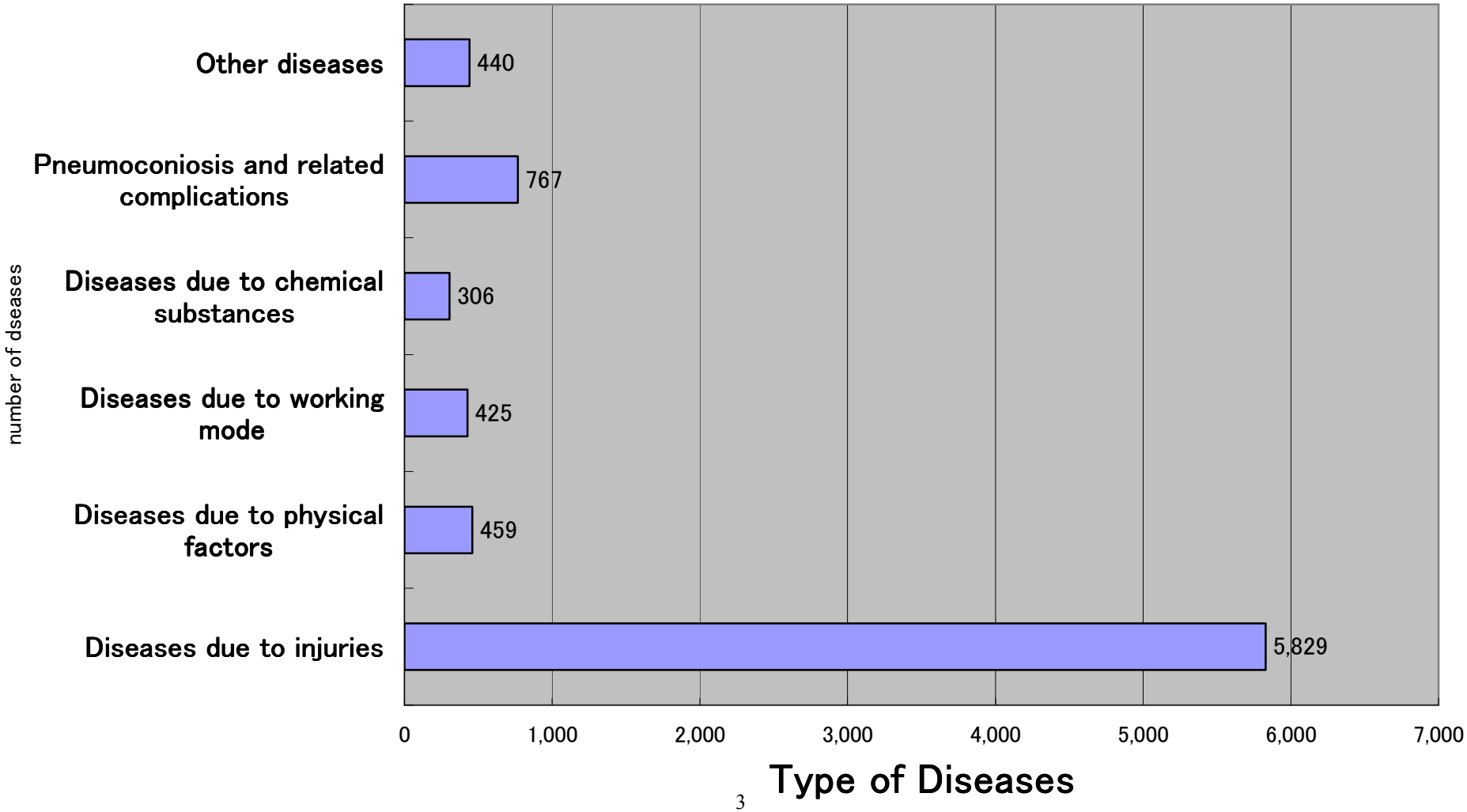


Fig.2 Occupational Diseases by Type 2005



As shown in Fig. 2, injuries (5,329persons) were the number one cause of occupational diseases in 2004, followed by pneumoconiosis and related complications (767 persons), diseases due to physical factors (459 persons), diseases due to working mode (425 persons), and diseases due to chemical substances (306 persons). In addition, 440 persons suffered from health problems stemming from other diseases.

Source: *Survey of Occupational diseases* and *Survey on the results of Pneumoconiosis Control* (Ministry of Health, Labour and Welfare)

Notes:
1. "physical factors" means noise, extreme temperatures, etc
2. "working mode" means heavy lifting, repetitive stress, etc.
3. The figure for "Pneumoconiosis and related complications" represents the sum of persons suffering from cases classed as Pneumoconiosis Management Classification 4, and the number of persons suffering from pneumoconiosis-related complications (including cases of "application at will").

Fig. 3 shows the annual figures since 1983 for the number of occupational diseases stemming from the four most common causes (injuries; pneumoconiosis and related complications; unhealthy physical factors in the environment; and unhealthy physical exertion).
We can see that there were large numbers of occupational diseases in Japan in the 1970s and 80s. Since then, these numbers have generally been falling thanks to measures that the Japanese government and companies have taken to improve management of the work environment.
The occurrence of pneumoconiosis, although both the number and ratio of newly detected pneumoconiosis of examined workers (defined as persons who have been tested for pneumoconiosis and been placed in Pneumoconiosis Management Classification 2 or higher) have both fallen, has not been greatly reduced. And also, the number of persons suffering from pneumoconiosis or related complications (defined as persons who have been placed in Pneumoconiosis Management Classification 4, and persons who have been diagnosed as suffering from pneumoconiosis-related complications) has changed very little (as shown in Fig. 4).
However, I would like to say, thanks to the development of the countermeasures shown in Fig.4, both the number and ratio of newly detected pneumoconiosis of examined workers have both fallen considerably. These countermeasures contribute to the improvement of the prevention of Pneumoconiosis.
And, Occupational diseases due to chemical substances remain almost unchanged, totalling over 300 persons per year.

Fig. 3 Occupational diseases in Japan since 1983

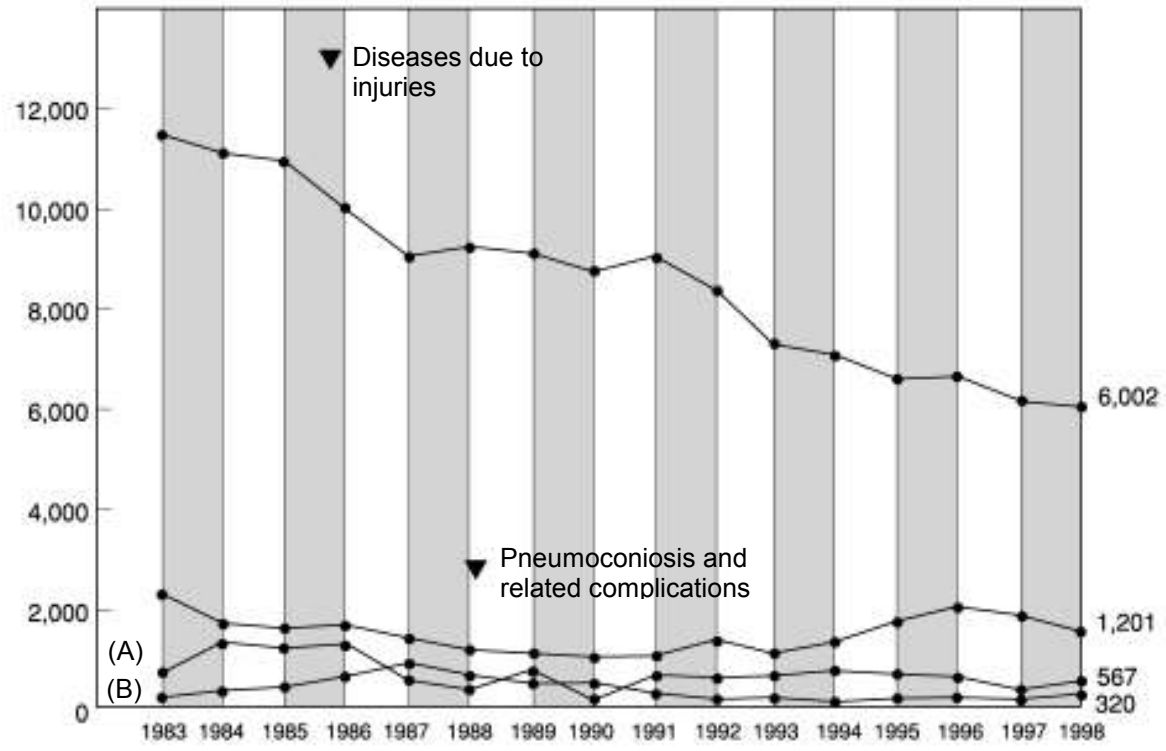
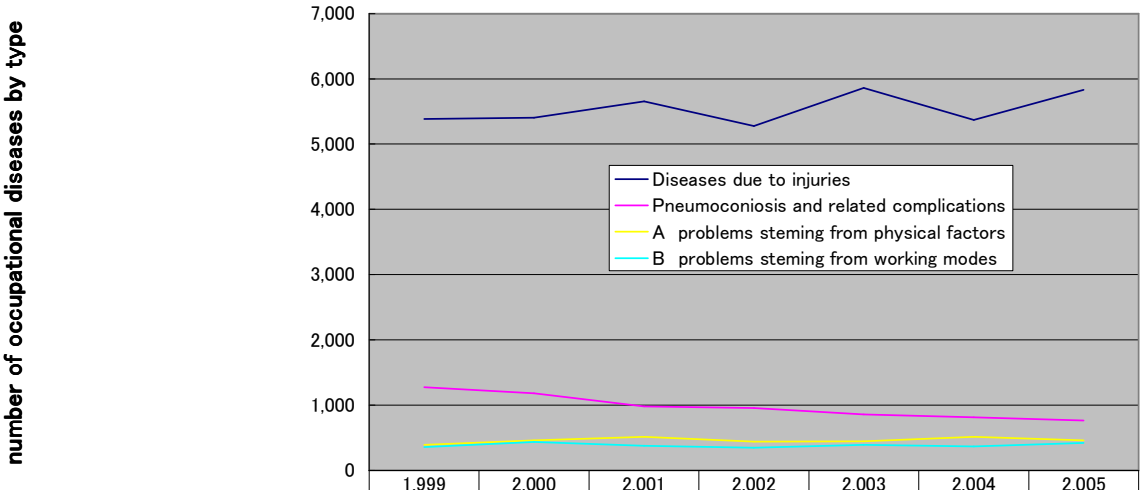


Fig. 3 (continued)



	1,999	2,000	2,001	2,002	2,003	2,004	2,005
Diseases due to injuries	5,388	5,405	5,652	5,277	5,861	5,370	5,829
Pneumoconiosis and related complications	1,276	1,180	982	956	856	814	767
A problems steming from physical factors	395	461	517	443	447	513	459
B problems steming from working modes	357	438	381	346	393	368	425

Note: "A" shows problems stemming from physical factors.
"B" shows problems stemming from working formats.

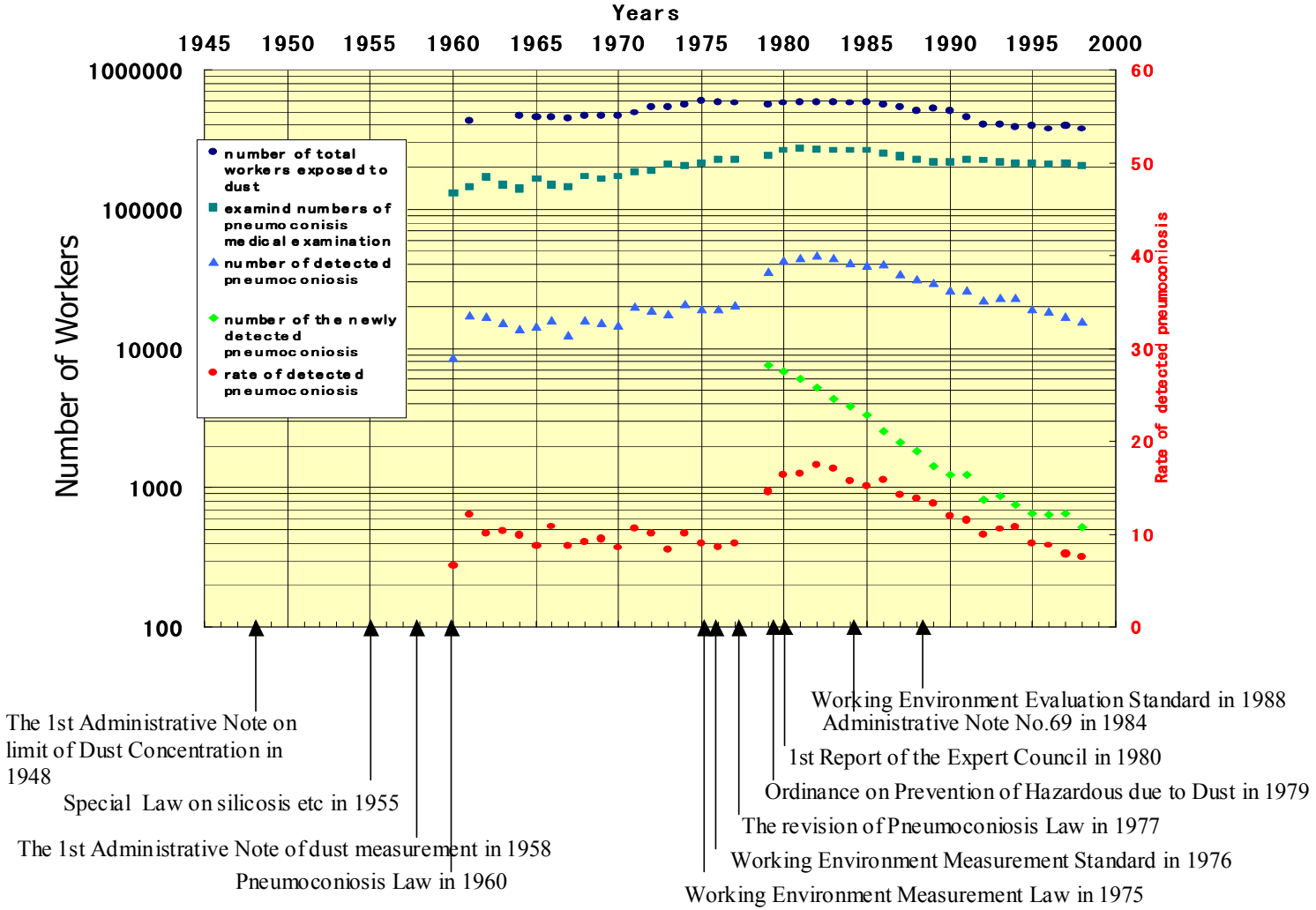


Fig.4 Result of medical examinations for pneumoconiosis

2. System for work environment control

With regard to the prevention of occupational diseases due to toxic chemical substances, and prevention of pneumoconiosis and related complications, the system for work environment control is as described below in Table 1.

Table 1 System for Work Environment Control in Japan

(1)	Identification of the toxicity of chemical substances used as raw materials, determination of the degree of exposure of workers to these substances, and assessment of the expected impact upon their health.
(2)	Halting the use of toxic raw materials. Switch to less toxic raw materials.
(3)	Improvement of production processes and work methods in order to prevent the release of toxic substances.
(4)	Adoption of airtight, automated, and/or remote control production equipment. Isolation of toxic processes
(5)	Use of local exhaust ventilation systems (including push-pull type exhaust ventilation equipment) in order to minimize worker exposure to toxic substances.
(6)	Limitation of the use of general ventilation systems to certain specific conditions in order to lower the concentration of toxic substances in such systems.
(7)	Measurement of work environments in order to check the effectiveness of work environment measurement.
(8)	Evaluation of the results of work environment measurements
(9)	Installation of equipment required resolving any problems that may be identified by a work environment measurement. (Installation of local exhaust ventilation systems [including push-pull type exhaust ventilation equipment], and general ventilation systems, when the work environment allows the use of such systems.)
(10)	Control of work methods. (Use of personal protective equipment when there is a risk of exposure to high concentrations of toxic substances; limitation of time spent working under such conditions; etc.)
(11)	Health management (special medical examinations on a regularly scheduled basis for persons engaged in work involving exposure to toxic substances)
(12)	Occupational Health education for workers (training in various subjects, including: proper work methods for persons working in a toxic environment; health effects of toxic substances; maintenance of local exhaust ventilation systems [including push-pull type exhaust ventilation equipment] and general ventilation systems; etc.)

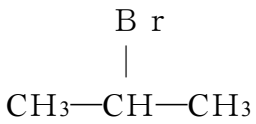
3. Identification of the toxicity of chemical substances used as raw materials, determination of the tolerance of workers to these substances, and assessment of the expected impact upon their health

I would like to tell you of how I learned from personal experience about the importance of item (1) in Table 1 above.

In the autumn of 1995, back when I was working at the Ministry of Labour, as the Director of the Chemical Substances Investigation Division of the Industrial Safety and Health Department, inside the Labour Standards Bureau, we received a very alarming piece of news from Japanese experts who had been sent to Korea to work with the Korean Industrial Safety Corporation (KISCO). At a Korean electronics factory that was using a Japanese-made cleaning compound containing 2-bromopropane (see Fig.5) as the main ingredient, both male and female workers were experiencing

serious health problems. Women experienced grave suppression of menstruation and showed a drop in their thrombocyte counts, while men had reduced sperm counts.

Fig.5 Chemical structure of 2-bromopropane



We immediately took a number of urgent measures to determine the nature of the problem. We called in various parties (including the Japanese manufacturer of the cleaning compound, Japanese chemical manufacturers that produced the 2-bromopropane domestically, and trading companies that imported 2-bromopropane from abroad) to question them about the situation. In addition, we also researched the available scientific literature on 2-bromopropane and conducted a survey of companies in Japan that were using cleaning compounds based on 2-bromopropane as the main ingredient. Our findings can be summarized in the following five points.

(1) The cleaning compound in question had been developed by its Japanese manufacturer as a substitute for another popular product that was due to be phased out because it contained CFC-113, a chemical that contributes to destruction of the ozone layer.

(2) It had already been reported in the scientific literature that 2-bromopropane: (a) was irritating to the eyes, lungs, and skin; (b) had an anesthetic effect; and (c) had a toxic effect upon the liver, kidneys, and heart. At the time of the product's development, however, nothing was known of its effect upon the reproductive system or the blood.

(3) Among the Japanese chemical manufacturers that produced 2-bromopropane domestically, one company provided clients with a warning not to use 2-bromopropane in cleaning compounds and other products meant to be used in an open environment (where there is a strong risk of worker exposure). This company explained that the reason for this warning was that 2-bromopropane contained bromine, and that its toxicity had not been fully verified. Apart from this one company, however, Japanese chemical manufacturers that made 2-bromopropane provided clients with no such warning, nor did any of the trading companies that imported it.

I believe that the company that provided its clients with a warning regarding the possible toxicity of 2-bromopropane deserves to be greatly lauded for its action.

(4) A study carried out in South Korea concluded that the chances were very high that the reproductive irregularities and other health problems experienced by the South Korean workers were very probably the result of exposure to 2-bromopropane.

(5) Japanese workplaces using cleaning compounds based on 2-bromopropane as the main ingredient had not reported any unusual occurrence of health problems.

In December 1995, the Chemical Substances Investigative Division sent out notices to Japanese

industrial organizations and all of Japan's Prefectural Labour Standards Bureau calling on them to take urgent action to prevent workers from being exposed to 2-bromopropane. In our notices we explained that there was a very high probability that exposure to 2-bromopropane can result in serious reproductive problems and other health disorders. Our division also informed KISCO in Korea of the measures that had been taken to address the problem in Japan.

4. Carrying out appropriate the work environment measurement

The concept of work environment control was first incorporated into occupational safety and health legislation in Japan when the Industrial Safety and Health Law was enacted in 1972. Article 65 of this law requires employers to carry out work environment measurement in order to facilitate work environment control. An early precursor to this legislation had already appeared, however, in the form of Labour Standards Bureau Issuance No. 1178, 1948. Prior to passage of the Industrial Safety and Health Law, Article 42 of the Labour Standards Law already required companies to take steps to prevent work environments from having an adverse effect on the health of their employees. The Ordinance on the Prevention of Organic Solvent Poisoning, which was enacted in 1960, was intended as a means of helping to ensure the achievement of this goal. The Ordinance requires the use of local exhaust ventilation systems where certain organic solvents are handled, and it specifies the controlled wind velocity at which these ventilators must be set to eliminate organic solvent from the work environment. In order to ascertain that the local exhaust ventilation systems in a given workplace are functioning effectively, companies are further required to install detector tubes. However, the Ordinance did not mandate the achievement of specific numerical targets, thus this Ordinance did not constitute the basis of "work environment control" as we understand the term today.

The Ordinance on the Prevention of Organic Solvent Poisoning was passed in response to a rash of health problems suffered by workers exposed to benzene in connection with the home-based production of "Hep-sandals." (This name derives from Audrey Hepburn, who wore sandals in the American movie "Roman Holiday" which became a huge hit product in Japan.)

Audrey Hepburn in "Roman Holiday"

The Ordinance required the use of work environment measurements in workplaces where certain organic solvents were used.
After this wave of benzene poisoning incidents, the manufacture of rubber cement containing benzene was prohibited in Japan in November 1959. Since 1975 benzene has been regulated as a carcinogenic substance, and its use in organic solvents is in principle prohibited.

With the 1971 passage of the Ordinance on Prevention of Hazards due to Specified Chemical Substances, the regulatory system changed. The regulation method based on the number of tasks, which had formerly been used, was abandoned in favour of a system based on the concept of work environment control, in which toxic chemical substances were subject to "concentration limits."

Article 65 of the Industrial Safety and Health Law of 1972 required companies to carry out work environment measurements, and to adopt work environment control solutions based on the results of these measurements. Further legislation designed to ensure that companies would address problems in a comprehensive manner did not come along until 1975, when this need was addressed by the Working Environment Measurement Law, as well as by Article 65 of the Industrial Safety and Health Law after the latter was amended in that same year. With regard to indoor workplaces where workers are exposed to toxic substances (as well as other workplaces where workers are exposed to significant health risks), these new items of legislation required that employers carry out regularly scheduled measurements (in principle, at least once every six months), in accordance with the provisions of the Minister of Labour's Work Environment Measurement Standards. Since April 30, 1977 the law has required that work environment measurements be carried out by either a work environment measurement expert, or by a registered work environment measurement agency hired from outside the company.

The requirement to have work environment measurements carried out (either by a work

environment measurement expert or a registered work environment measurement agency) ensured that these measurements would be carried out in a scientific manner by properly qualified experts using proper design, sampling, and assay techniques. (Article 2, Section 4 of the Industrial Safety and Health Law requires that companies "carry out design, sampling, and assays (including analysis) to determine the safety of the air and other elements of the work environment.") This new legislation brought considerable progress in the field of work environment measurement.

I would like to emphasize one key difference between the way work environment measurement is carried out in Japan and in the West. Work environment measurement in Japan is used as a means of assessing the state of work environment control and, when the results of the assessment indicate a necessity, of devising measures to improve the work environment. In the West, on the other hand, the degree of exposure of individual workers is often measured; but we do little of this in Japan.

5. Work environment measurement in Japan

The main purpose of work environment measurements is to obtain an accurate understanding of the working conditions of employees who work in toxic environments, so as to determine what equipment needs to be installed in order to improve the work environment. A work environment measurement must be objective and accurate.

For this reason, the Minister of Labour's Work Environment Measurement Standards include stipulations regarding the following aspects of work environment measurements:

(1) The method of defining what constitutes a unitary workplace
(2) The method of determining what must be measured
(3) The method of determining the timing and duration of measurements
(4) The type and performance of analysis equipment to be used for carrying out measurements

6. Evaluating the results of work environment measurements

With regard to evaluation of the results of work environment measurements, the government has issued administrative guidance for the past 15 years urging companies to carry out their evaluations in accordance with a Labour Standards Bureau circular issued in February 1984. In a further effort to ensure that companies would evaluate the results of work environment measurements in an effective and appropriate manner, and to ensure that companies would pursue whatever measures that such evaluations revealed to be necessary, the Industrial Safety and Health Law was amended in February 1988 (a new clause was added to Article 65-2). The amended law required companies to take the results of work environment measurements as the basis in carrying out work environment measurement evaluations in accordance with the provisions of the Minister of Labour's Work Environment Measurement Standards. Large numbers of workplaces throughout Japan now carry out systematic work environment management in accordance with the requirements of the Work Environment Measurement Evaluation Standards.

7. How the results of work environment measurements are evaluated in Japan, and post-evaluation follow-up measures

After the results of work environment measurements are evaluated, the work environment in question is classed into one of three categories (Control Classification 1, Control Classification 2, and Control Classification 3), as required by the Minister of Labour's Work Environment Measurement Evaluation Standards (Table 2). The Standards serve as an indicator of the quality (or lack thereof) of the work environment management at a given workplace, and are used for evaluating workplaces where employees are exposed to dust, specified chemical substances, lead, and organic solvents.
Fig.6 provides a flow chart that summarizes the content of what I have described above (work environment measurement; evaluation of the results thereof; the type of working conditions corresponding to the three control classifications; and the measures that must be taken to address problems).

Evaluations are carried out in accordance with the provisions of the Work Environment Measurement Evaluation Standards (table 2). This process is summarized in Fig. 6 as well as Table 3.

Table 2

Working Environment Evaluation Standards

Ministry of Labour Notification No. 79 of September 1, 1988

Latest Amendments:
Ministry of Health, Labour and Welfare Notification No.369 of April 1, 2005

(Scope)

Article 1. This notification shall apply to workshops listed in items l, 7, 8 and 10 metallic materials or carbon in the air of such indoor workplaces prescribed in item 1, Article 21, the Enforcement Order of Industrial Safety and Health Law (Cabinet Order No. 318, 1972, hereinafter referred to as the Cabinet Order) shall be measured in accordance with the provisions specified in the following :

(Evaluation of the Results of the Measurement)

Article 2. Evaluation of the results of the working environment measurement prescribed in paragraph 1 of Article 65-2 of the Industrial Safety and Health Law shall be carried out by classifying into Control Class 1 to Control Class 3 as listed in the right column of the following table, according to the case in following items, for each unit work area, prescribed in item 1 of paragraph 1 of Article 2 of Working Environment Measurement Standards (Ministry of Labour Notification No. 46, 1976), hereinafter the same.

(1) In cases where only A Sampling (sampling carried out according to items 1 to 2 of paragraph 1 of Article 2 of the Working Environment Measurement Standards, including cases where the same provisions are applied mutatis mutandis in paragraph 4 of Article 10, paragraph 2 of Article 11 or paragraph 4 of Article 13, hereinafter the same), has been carried out.

Control Class	2 of paragraph 1 of Article 2 of the Working Environment Measurement level for the substances to be measured as prescribed in Attached Table
Control Class I	1st evaluation value is less than administrative control level
Control Class II	1st evaluation value is equal to or more than administrative control level and 2nd evaluation value is equal to or less than administrative control level
Control Class III	2nd evaluation value is more than administrative control level

(2) In cases where both A Sampling and B Sampling (sampling carried out with the provision of item 2-2 of paragraph 1 of Article 2 of the Working Environment Measurement Standards, including cases where the same provisions are applied mutatis mutandis in paragraph 4 of Article 10, paragraph 2 of Article 11 or paragraph 4 of Article 13, hereinafter the same), have been carried out.

Control Class	Result of comparison of evaluation value or measured value of B sampling and administrative control level for the substances to be measured as prescribed in Attached Table .
Control Class I	Both 1st evaluation value and measured value of B sampling (in cases where B sampling was carried out at more than 2 sampling points, the largest value shall be adopted, hereinafter the same) are less than administrative control level
Control Class II	2nd evaluation value is equal to or less than administrative control level, and measured value of B sampling is equal to or less than 1.5 times administrative control level (excluding cases classified as Control Class I)
Control Class III	2nd evaluation value is more than administrative control Level, or measured value of B sampling is more than 1.5 times administrative control level

2. In a unit work area which has sampling points where the concentration of substances to be measured was less than the lower limit value of the sampling method or the analysis method adopted for the measurement, the lower limit value should be used as the measured value of the point to carry out the classification of the preceding paragraph.

3. In a unit work area which has sampling points where the concentration of substances to be measured was less than one tenth of Administrative Control Level, classification of paragraph 1 may carried out by using one tenth of the Administrative Control Level as the measured value of the measuring point.

4. In a unit work area pertaining to a mixture including more than 2 organic solvents stated in items 1 to 47 of Attached Table 6-2 of the Enforcement Order of Industrial Safety and Health Law, classification of paragraph 1 should be carried out by using a converted value calculated by the following formula for each sampling point. In this case, I shall be used as the Administrative Control Level.

$$C = \frac{C_1}{E_1} + \frac{C_2}{E_2} +$$

In this formula, C, C_1, C_2..... and E_1, E_2..... represent the following values.

C	Converted Value
C_1, C_2	Measured value for each organic solvent to be measured
E_1, E_2	Administrative Control Level for each organic solvent to be measured

(Calculation of Evaluation Value)

Article 3. 1st evaluation value and 2nd evaluation value of paragraph 1 of preceding Article should be calculated by the following formulae.

$$\log E_{A1} = \log M_1 + 1.645\sqrt{\log^2 \sigma_1 + 0.084}$$

$$\log E_{A2} = \log M_1 + 1.151\ (\log^2 \sigma_1 + 0.084)$$

In these formulae, E_{A1}, M_1, σ_1 and E_{A2} represent the following values.

E_{A1}	1st evaluation value
M_1	Geometrical mean of measured values of A sampling
σ_1	Geometrical standard deviation of measured values of A sampling
E_{A2}	2nd evaluation value

2. Notwithstanding the provision of' the preceding paragraph, in cases when measurement was conducted for 2 successive workdays (in case there was rational reason why the measurement could not be conducted for 2 successive workdays, 2 workdays with the minimum interval), 1st evaluation value and 2nd evaluation value can be calculated by the following formulae.

$$\log EA_1 = \frac{1}{2}(\log M_1 + \log M_2) + 1.645\sqrt{\frac{1}{2}(\log^2 \sigma_1 - \log^2 \sigma_2) + \frac{1}{2}(\log M_1 - \log M_2)^2}$$

$$\log EA_2 = \frac{1}{2}(\log M_1 + \log M_2) + \left\{\frac{1}{2}(\log^2 \sigma_1 + \log^2 \sigma_2) + \frac{1}{2}(\log M_1 - \log M_2)^2\right\}$$

In these formulae, E_{A1}, M_1, M_2, σ_1, σ_2 and E_{A2} represent the following values.

E_{A1}	1st Evaluation Value
M_1	Geometrical mean of measured values of A sampling for 1st day
M_2	Geometrical mean of measured values of A sampling for 2nd day
σ_1	Geometrical standard deviation of measured values of A sampling for 1st day
σ_2	Geometrical standard deviation of measured values of A sampling for 2nd day
E_{A2}	2nd Evaluation Value

Attached Table

Kinds of substances	Administrative Control Level
1. Dust of sand and stones, rocks, ores(minerals), metallic materials or carbon	$E = \frac{3.0}{0.59Q + 1}$ E administrative control level (mg/m3) Q content of free silica(percent)
2. Acrylamide	0.3 mg/m^3
3. Acrylonitrile	2 ppm
4. Alkyl mercury compounds (restricted to the substances in which alkyl radicals are methyl or ethyl radicals)	0.01 mg/m^3 as mercury
5. Ethylenimine	0.5 ppm
6. Ethylene oxide	1 ppm
7. Vinyl chloride	2 ppm
8. Chlorine	0.5 ppm
9. Chlorodiphenyl (otherwise known as PCB)	0.1 mg/m^3
10. Cadmium and its compounds	0.05 mg/m^3 as cadmium
11. Chromic acid and its salts	0.05 mg/m^3 as chromium
12. Vanadium pentoxide	0.03 mg/m^3 as vanadium
13. Coaltar	0.2 mg/m^3 as benzene solubility
13-2 Arsenic trioxide	0.003mg/m3 as Arsenic
14. Potassium cyanide	3mg/m^3 as cyanogen
15. Hydrogen cyanide	3 ppm
16. Sodium cyanide	3 mg/m^3 as cyanogen
17. 3,3' -Dichloro-4,4' -diamino diphenyl methane	0.005 mg/m^3
18. Methyl bromide	5 ppm
19. Dichromic acid and its salts	0.05 mg/m^3 as chromium
20. Mercury and its inorganic compounds (excluding mercury sulfide)	0.025 mg/m^3 as mercury
21.Tolylene diisocyanate	0.005 ppm
22. Nickel carbonyl	0.001 ppm
23. Nitroglycol	0.05 ppm
24. p-nitro chlorobenzene	0.6mg/m^3
25. Hydrogen fluoride	2 ppm
26. ß-Propio lactone	0.5 ppm
27. Beryllium and its compounds	0.002 mg/m^3 as beryllium
28. Benzene	1ppm
29. Pentachlorophenol (otherwise known as PCP) and its sodium salts	0.5 mg/m^3 as penta chlorophenol
30. Manganese and its compounds (excluding basic manganese oxide)	0.2mg/m^3 as manganese
31. Methyl iodide	2 ppm

32. Hydrogen sulfide	5 ppm
33. Dimethyl sulfate	0.1 ppm
33-2 Asbestos	0.15 F/cm^3 as fibers longer than 5 μm
34. Lead and its compounds	0.05mg/m^3 as lead
35. Acetone	500 ppm
36. Isobutyl alcohol	50 ppm
37. Isopropyl alcohol	200 ppm
38. Isopentyl alcohol (otherwise known as isoamyl alcohol)	100 ppm
39. Ethyl ether	400 ppm
40. Ethyleneglycol monoethyl ether (otherwise known as cellosolve)	5 ppm
41. Ethyleneglycol monoethyl ether acetate (otherwise known as cellosolve acetate)	5 ppm
42. Ethyleneglycol mono-n-butyl ether (otherwise known as butyl cellosolve)	25 ppm
43. Ethyleneglycol monomethyl ether (otherwise known as methyl cellosolve))	5 ppm
44. o-Dichlorobenzene	25 ppm
45. Xylene	50 ppm
46. Cresol	5 ppm
47. Chlorobenzene	10 ppm
48. Chloroform	10 ppm
49. Isobutyl acetate	150 ppm
50. Isopropyl acetate	100 ppm
51. Isopentyl acetate (otherwise known as isoamyl acetate)	100 ppm
52. Ethyl acetate	200 ppm
53. n-Butyl acetate	150 ppm
54. n-Propyl acetate	200 ppm
55. n-Pentyl acetate (otherwise known as n-amyl acetate)	100 ppm
56. Methyl acetate	200 ppm
57. Carbon tetrachloride	5 ppm
58. Cyclohexanol	25 ppm
59. Cyclohexanone	25 ppm
60. 1,4-Dioxane	10 ppm
61. 1,2-Dichloroethane (otherwise known as ethylene dichloride)	10 ppm
62. 1,2-Dichloroethylene (otherwise known as acetylene dichloride)	150 ppm
63. Dichloromethane (otherwise known as methylene dichloride)	50 ppm
64. N,N-Dimethylformamide	10 ppm
65. Styrene	20 ppm
66. 1,1,2,2-Tetrachloroethane (otherwise known as tetrachloroacetylene)	1 ppm
67. Tetrachloroethylene (otherwise known as	50 ppm

perchloroethylene)	
68. Tetrahydrofuran	200 ppm
69. 1,1,1-Trichloroethane	200 ppm
70. Trichloroethylene	25 ppm
71. Toluene	50 ppm
72. Carbon disulfide	10 ppm
73. n-Hexane	40 ppm
74. 1-Butanol	25 ppm
75. 2-Butanol	100 ppm
76. Methanol	200 ppm
77. Methyl isobutyl ketone	50 ppm
78. Methyl ethyl ketone	200 ppm
79. Methyl cyclohexanol	50 ppm
80. Methyl cyclohexanone	50 ppm
81.Methyl n-butyl ketone	5 ppm

Note; These data mentioned above means the concentrations at 25 centigrade as well as 1013 hectopascal.

Fig.6 Work environment measurement flow chart

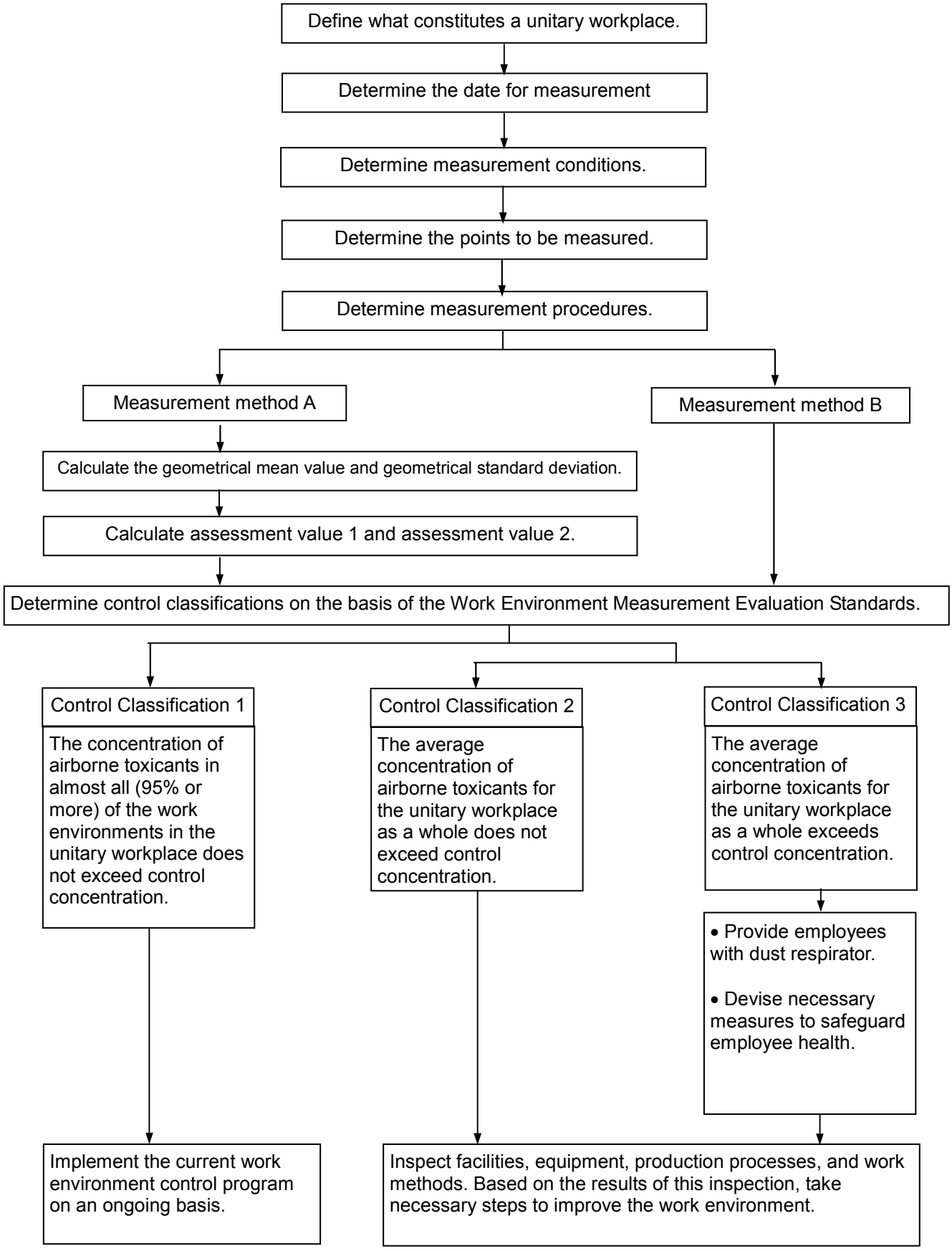


Table 3 Control Class, Control Level and Measures to be taken.

Control Class Ⅲ	2nd control level
Control Class Ⅱ	1st control level
Control Class Ⅰ	

(1) Condition and Measures Shall Be Taken for Each Control Class

Evaluation and Improvement of Working Environment

Control Class	Condition of working area	Measures to be taken
Control Class Ⅰ	Concentration of airborne toxic Substances at almost (more than 95％) points in a unit work area does not exceed the administrative control level	Continue the current working environment control to keep the present condition
Control Class Ⅱ	Mean concentration of airborne Toxic does not exceed the administrative control level	Endeavour to take necessary measures for working environment improvement, based on the result of inspection of facilities, equipment, working method, or working procedure
Control Class Ⅲ	Mean concentration of airborne toxic substances in a unit work area exceeds the administrative control level	1) Take necessary measures for working environment, based on the result of inspection of facilities, equipment, working method, or working procedure 2) Use effective respirator 3) Carry out medical examination or take other necessary actions to maintain workers' health

(2) Classification of Control Class

1. Only A-sampling

$E_{A1} < E$	$E_{A1} \geqq E \geqq E_{A2}$	$E_{A2} < E$
Control Class Ⅰ	Control Class Ⅱ	Control Class Ⅲ

2.Both A and B-sampling

	$E_{A1} < E$	$E_{A1} \geqq E \geqq E_{A2}$	$E_{A2} < E$
$C_B < E$	Control Class Ⅰ	Control Class Ⅱ	Control Class Ⅲ
$E_1 \geqq C_{B1} \geqq 1.5 \times E$	Control Class Ⅱ	Control Class Ⅱ	Control Class Ⅲ
$C_B > 1.5 \times E$	Control Class Ⅲ	Control Class Ⅲ	Control Class Ⅲ

E ：Administrative control level

E_{A1} ：1st Evaluation Value

E_{A2} ：2nd Evaluation Value

C_B ：B-sampling Value

The Ordinance on the Prevention of Organic Solvent Poisoning stipulates that workplaces where organic solvents are handled must install local exhaust ventilation systems. The Ordinance further stipulates that the capture velocity of these ventilators must be set at a specific level. However, a

workplace can obtain an exemption from this latter requirement and set the capture velocity on its local exhaust ventilation systems at a level below that specified by the Ordinance, provided that: (1) the results of work environment measurements show that the workplace has successfully maintained the concentration of toxic substances at a level corresponding to Control Classification 1 for at least one year and six months; (2) the workplace in question has been grouped in Control Classification 1 at least three consecutive times; (3) the workplace in question has received authorization from the director of the competent Labour Standards Inspection Office to lower the capture velocity setting on its local exhaust ventilation systems; and (4) it is deemed that the workplace in question will still be able to maintain a concentration level corresponding to Control Classification 1 even after it lowers the capture velocity setting on its local exhaust ventilation systems.

8 Implementation of the unified accuracy control project by the Ministry of Labour, Japan

The Ministry of Labour, Japan, entrusts Japan Association for Working Environment Measurement with the unified accuracy project (including cross check of the result of the working environment measurement etc.) in order to improve the design, sampling, assay (including analysis) and evaluation in working environment measurement agencies as well as to promote the appropriate evaluation of the result of work environment measurement and the implementation of the following countermeasure by employers etc.

9. Work environment control at small and medium-sized workplaces

Small and medium-sized workplaces are also required by law to carry out the work environment measurements described above, and to take such actions as are shown necessary by these measurements to insure proper work environment control. Japan's small and medium-sized workplaces, however, have not always necessarily had the personnel, technical expertise, or financial resources required for prompt compliance with this requirement. Nevertheless, small and medium-sized workplaces are showing an increasing understanding of how important it is that they take appropriate steps to safeguard the health of their employees before health problems occur. This fortunate trend has come about thanks to: (1) measures taken by the Ministry of Health, Labour and Welfare to support the efforts of small and medium-sized workplaces (and the business organizations to which they belong) in this regard; (2) monitoring and guidance provided by various government agencies in charge of labour standards administration; and (3) guidance provided by work environment control experts

10 .The progress achieved in recent years in the area of work environment control

As Fig.7 to Fig.13 shows, the distribution of Control Classes of each work places regarding each substance continues to be improved, for example, with respect to Average, in fiscal year 2002, as Fig.13 shows, 89.7 % of all workplaces were placed in Control Classification 1,. The proportion of workplaces in Control Classification 2 is 6.3 % and the proportion of workplaces in Control Classification 3 is 4.0 %, respectively.

Fig. 7 Dust

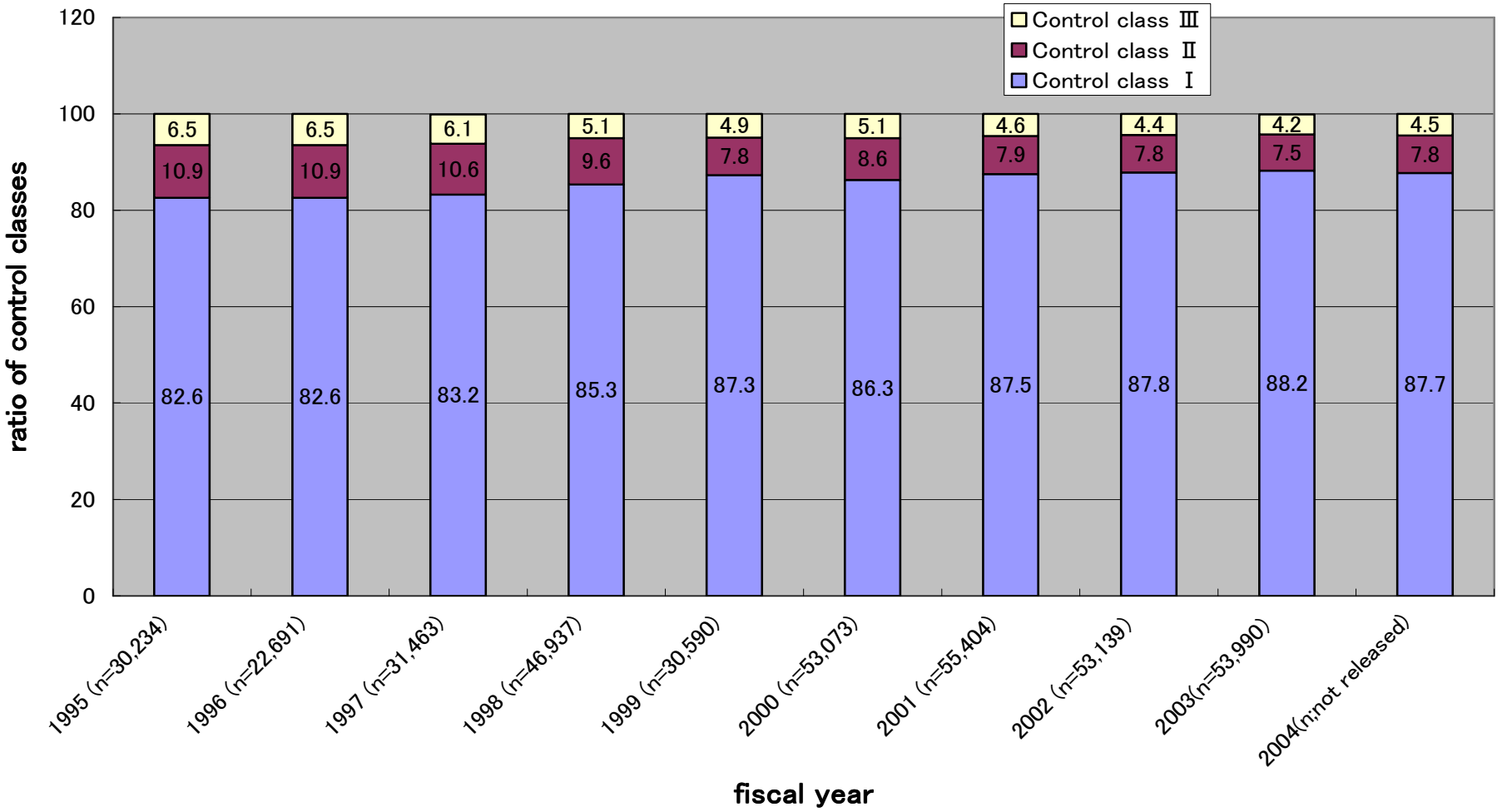

Control class Ⅲ
Control class Ⅱ
Control class Ⅰ
ratio of control classes
120
100
80
60
40
20
0
6.5
10.9
82.6
6.5
10.9
82.6
6.1
10.6
83.2
5.1
9.6
85.3
4.9
7.8
87.3
5.1
8.6
86.3
4.6
7.9
87.5
4.4
7.8
87.8
4.2
7.5
88.2
4.5
7.8
87.7
1995 (n=30,234)
1996 (n=22,691)
1997 (n=31,463)
1998 (n=46,937)
1999 (n=30,590)
2000 (n=53,073)
2001 (n=55,404)
2002 (n=53,139)
2003(n=53,990)
2004(n;not released)
fiscal year

Fig. 8 Asbestos

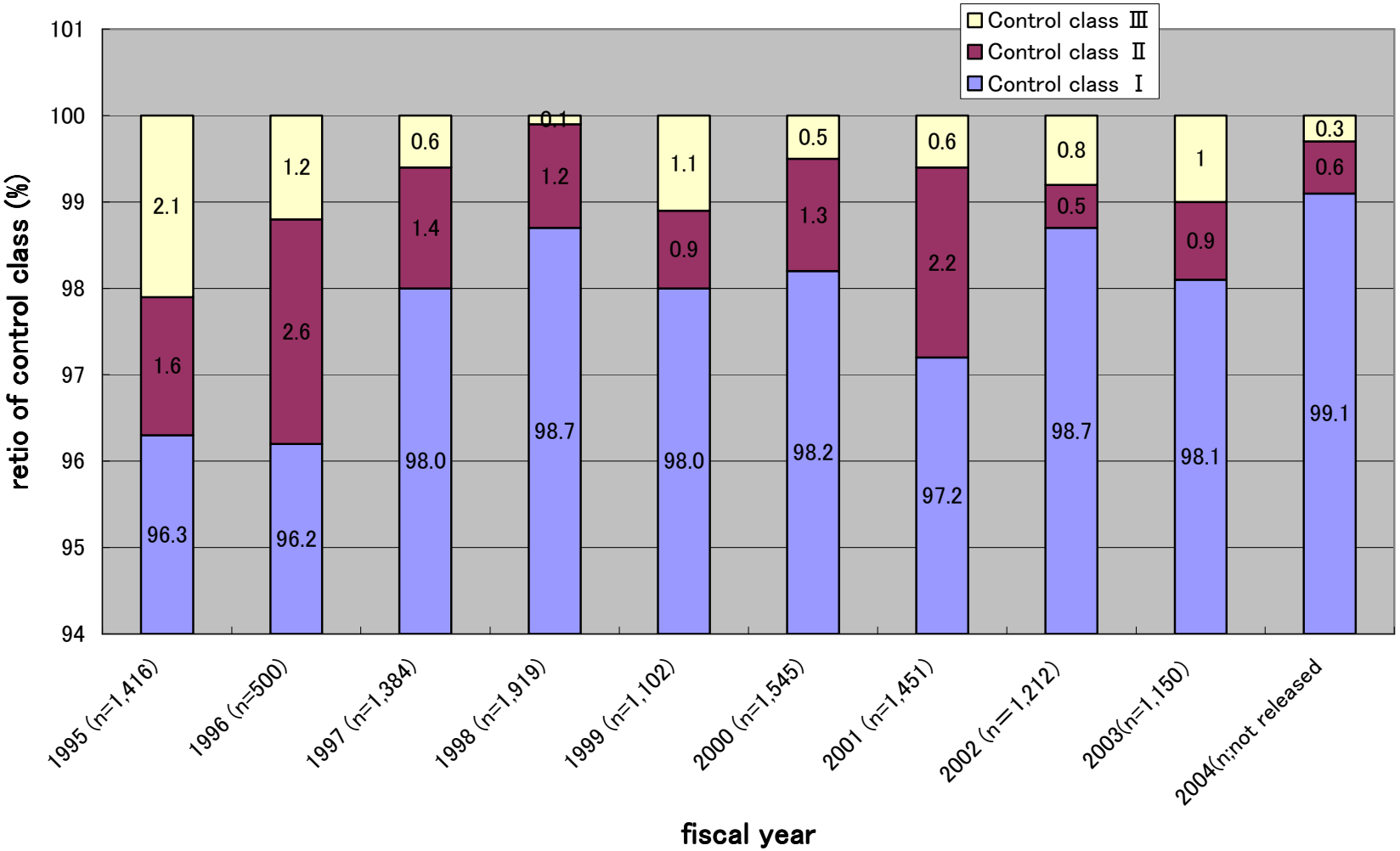


Fig. 9 Organic solvents

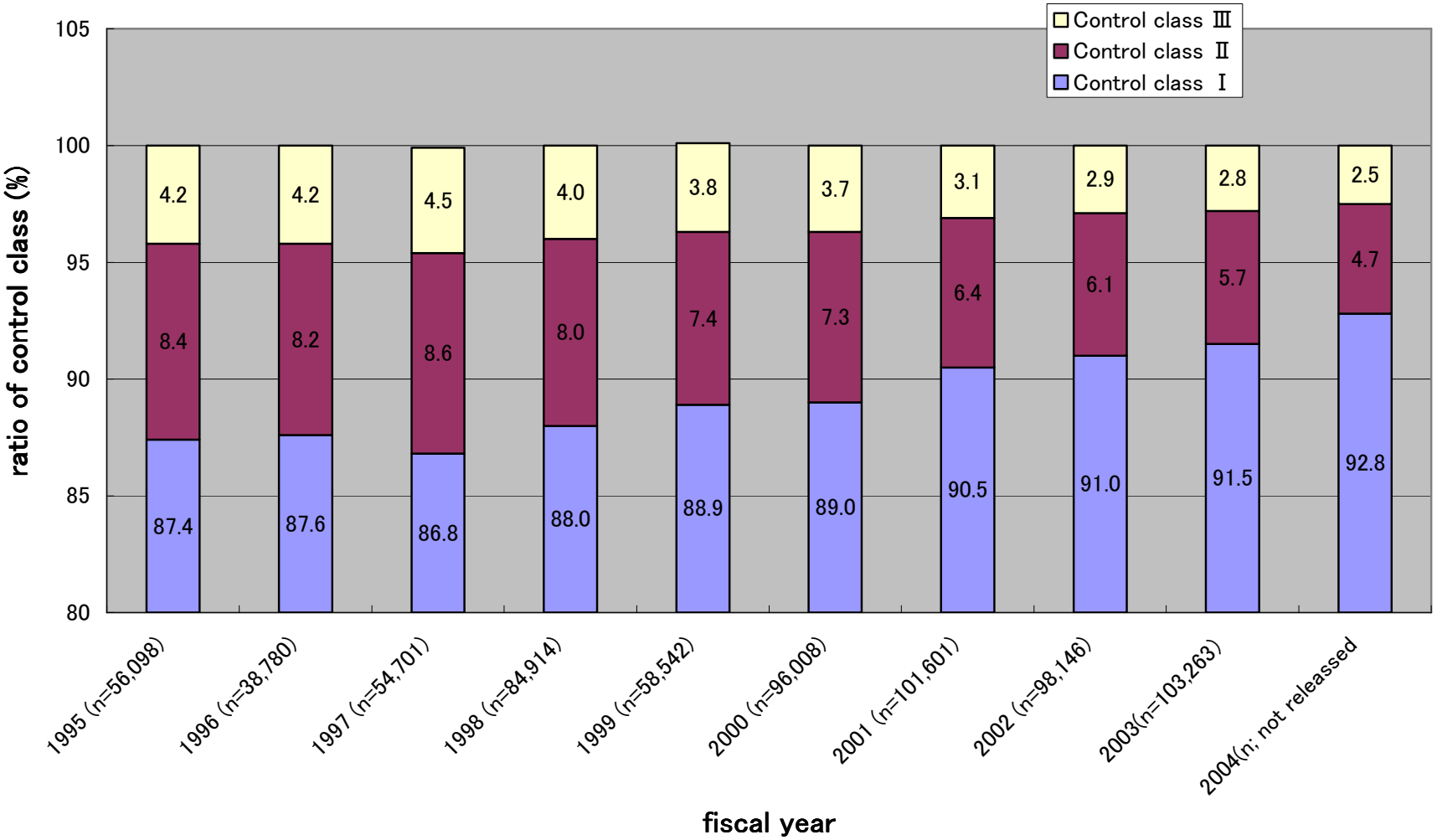


Fig. 10 Specified chemical substances othre than asbestos and metals, from fiscal 1995 to 2003

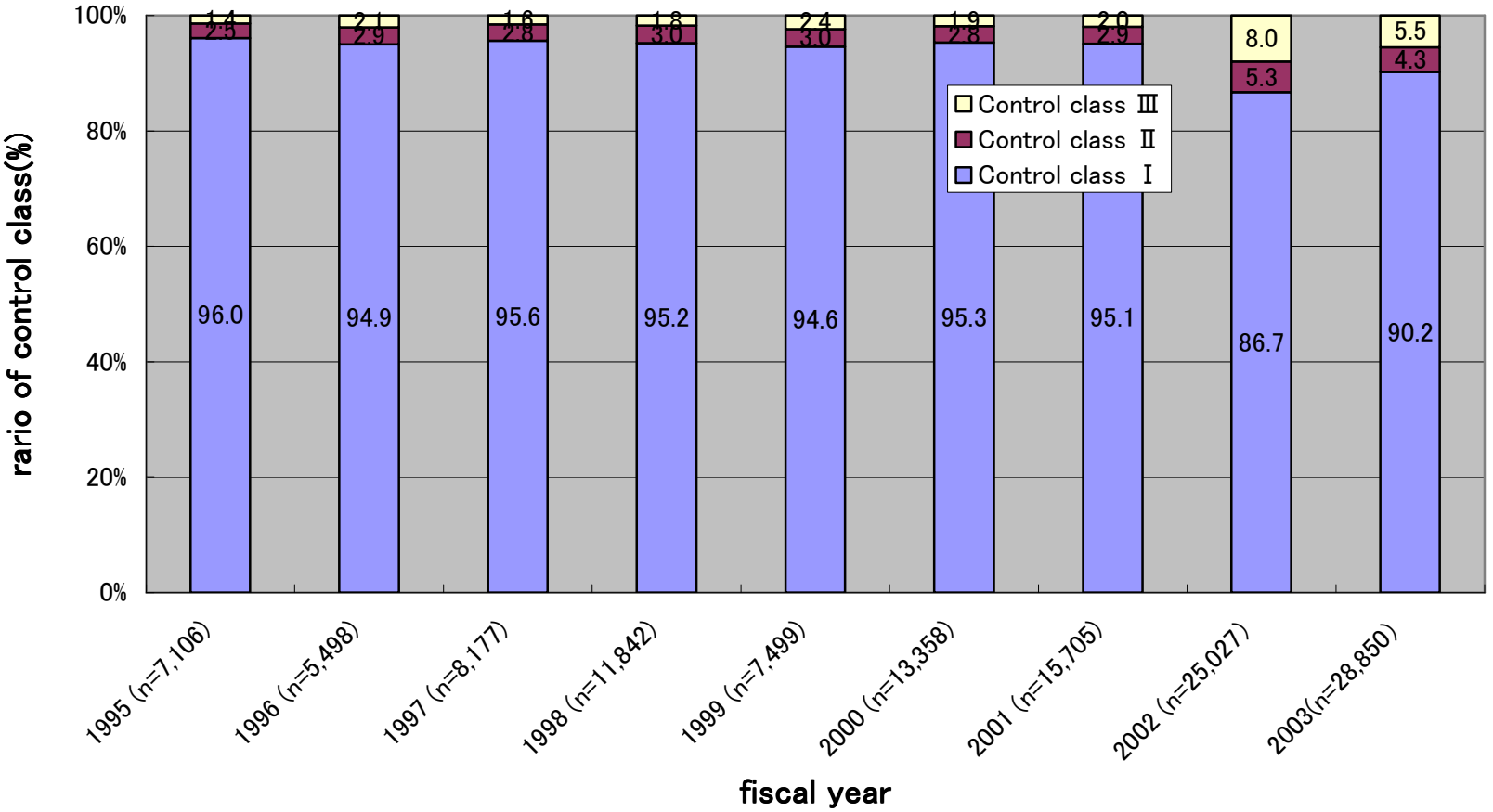


Fig. 11 Metals in Specified chemical substances in fiscal year 2004

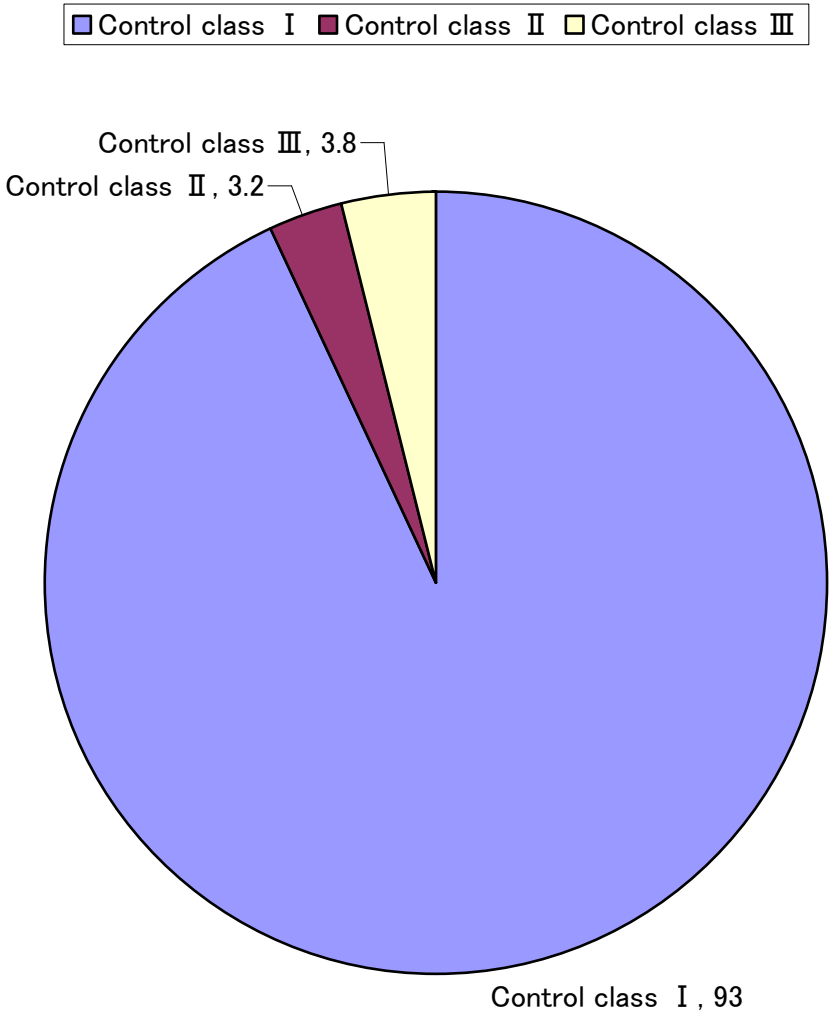
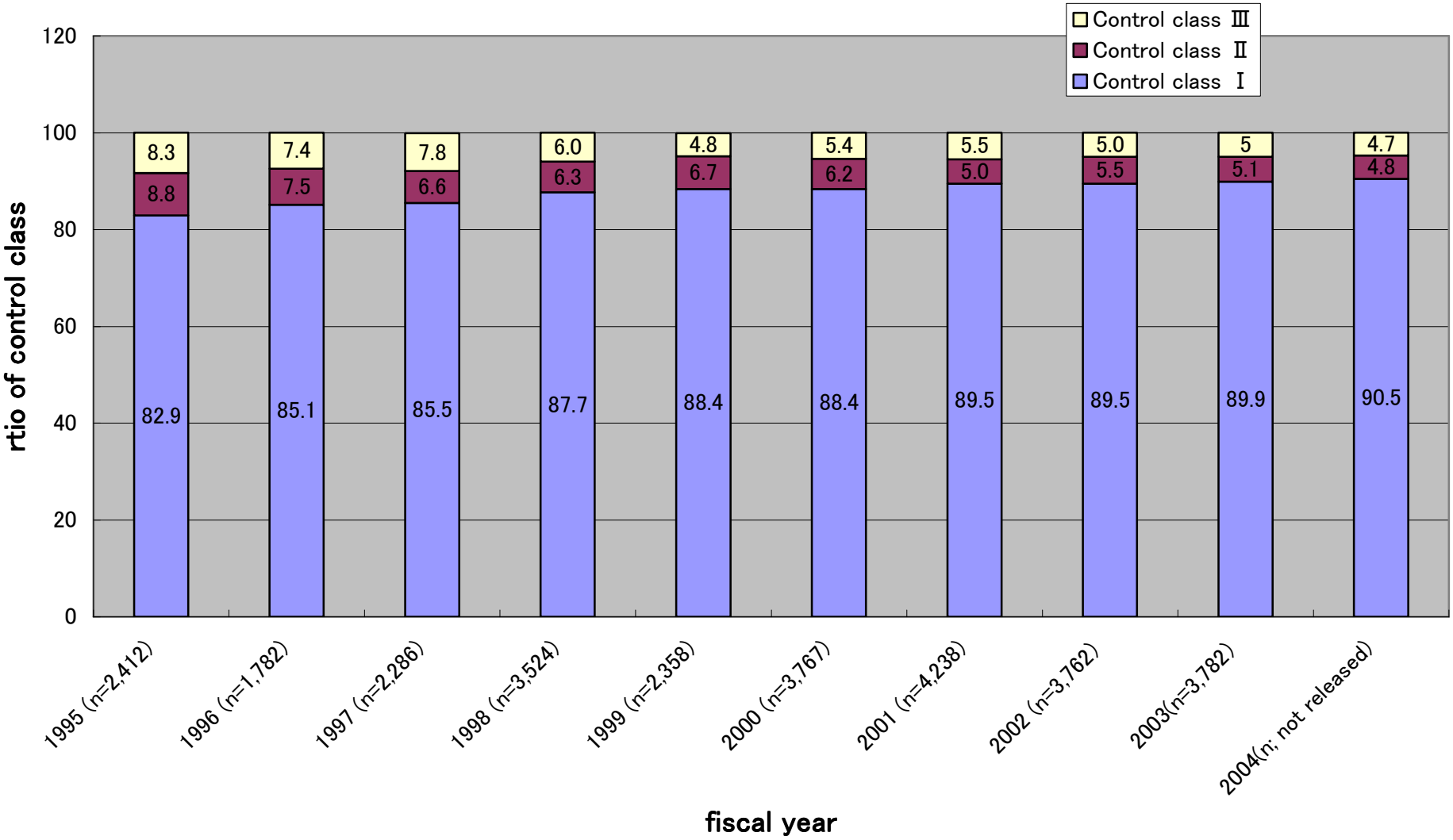


Fig. 12 Lead


Control class Ⅲ
Control class Ⅱ
Control class Ⅰ
rtio of control class
120
100
80
60
40
20
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8.3
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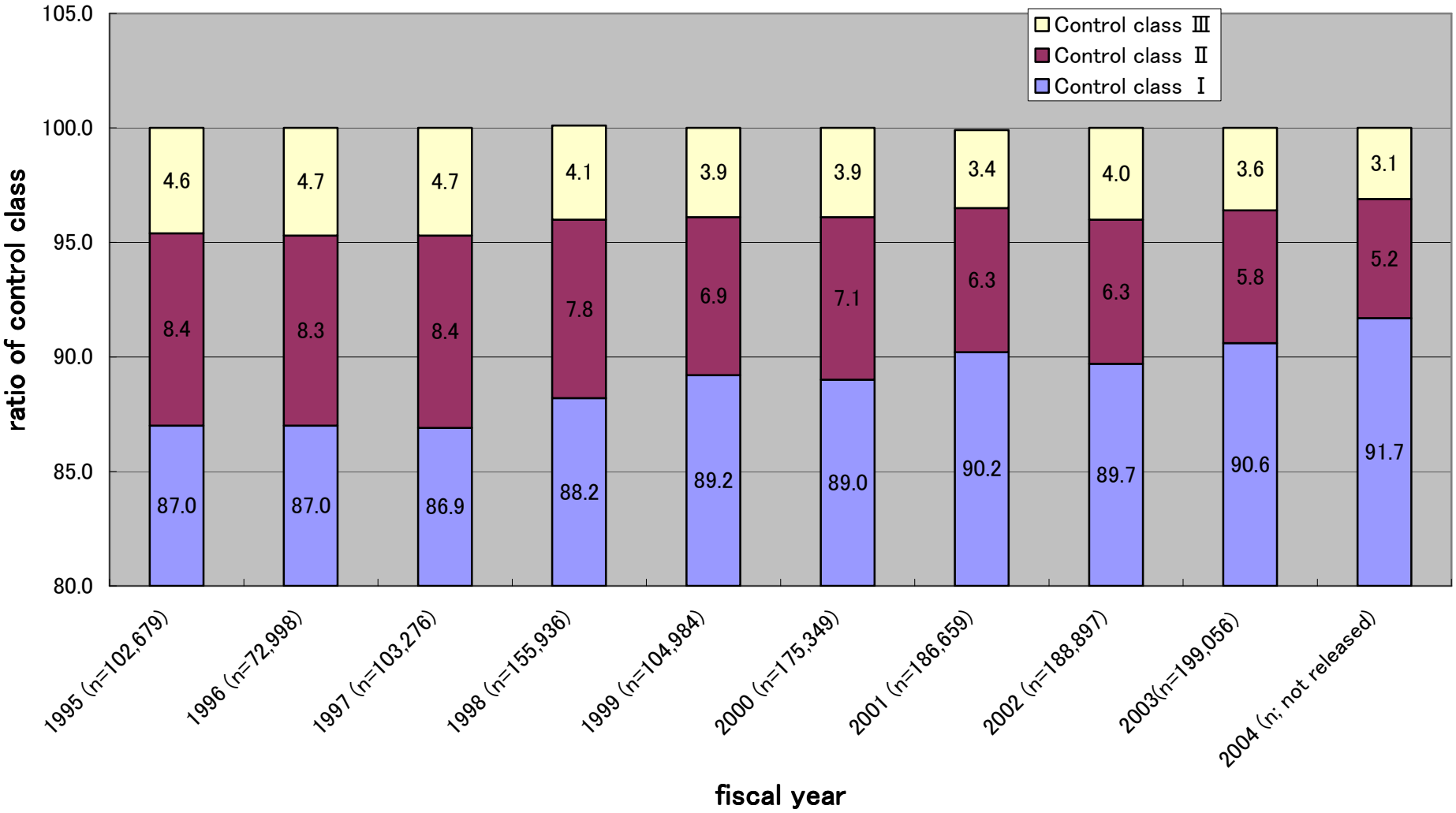
82.9
7.4
7.5
85.1
7.8
6.6
85.5
6.0
6.3
87.7
4.8
6.7
88.4
5.4
6.2
88.4
5.5
5.0
89.5
5.0
5.5
89.5
5
5.1
89.9
4.7
4.8
90.5
1995 (n=2,412)
1996 (n=1,782)
1997 (n=2,286)
1998 (n=3,524)
1999 (n=2,358)
2000 (n=3,767)
2001 (n=4,238)
2002 (n=3,762)
2003(n=3,782)
2004(n; not released)
fiscal year

Fig. 13 Average



11. Control of work methods

In addition to the installation or upgrading of various equipment (use of air-tight machinery, installation of local exhaust ventilation systems [including push-pull type exhaust ventilation equipment], etc.) on the basis of an evaluation of the result of work environment measurements, workplaces are also required to take immediately a number of other measures when they are deemed necessary. Such measures include: (1) having their employees wear personal protective equipment; (2) implementing shorter working hours; (3) changing work positions; etc.

12. Health care

The Industrial Safety and Health Law stipulates that employees whose work involves exposure to toxic substances must, in principle, be provided with a special medical examination once every six months. The results of work environment measurements are very helpful to industrial physicians when they carry out these special medical examinations.

A number of different indices are used to facilitate the effort to discover adverse health effects of toxic substances at the earliest possible moment. For this reason, employers are required by law to include biological monitoring concerning with certain special medical examination programs. Blood and/or urine tests can be used to check for the presence of various metabolites found in the blood and /or urine in the special medical examinations concerning with such organic solvents as xylene, N, N-dimethyl formamide, styrene, tetrachloroethylene, 1, 1, 1-trichloroethane, toluene and normal hexane as well as lead. The results of these tests provide very valuable information that helps determine the effectiveness of work environment control.

13. Occupational health education

In accordance with the requirements of the Industrial Safety and Health Law, employees whose work involves exposure to toxic substances must receive training regarding: (1) proper work methods; (2) the health impact of the toxic substances that they produce or handle; (3) the proper operation of local exhaust ventilation systems, push-pull ventilation equipment, etc.; (4) the proper use of personal protective equipment; etc. This training is indispensable if work environment control is to be carried out properly.

14. Occupational Safety and Health Management System

The release by the ISO of the ISO9000 series quality control standards and the ISO14000 series environmental management standards has sparked an international trend toward standardization of occupational safety and health management systems. BS8800 has now been released, and the ILO finalized and issued “Guidelines on occupational safety and health management systems ILO—OSH2001” in June 2001.

Table 4

Guideline on Occupational Safety and Health Management System
Notification No. 53, 1999, Ministry of Labour
Latest amendment on10th March, 2006

Contents

Japan's Ministry of Labour (Ministry of Health, Labour and Welfare of Today) issued its Occupational Safety and Health Management System recommendations on 30, April, 1999, and this guideline was amended in 2006. Its contents are shown in Table 4. The Ministry took this action in response to the growing recognition of two looming problems in the field of occupational safety and health, namely: (1) occupational diseases in Japan are no longer being reduced as quickly as they once had been; and (2) long-time veterans in the field of occupational safety and health have begun to retire, yet not enough has been done to ensure the smooth transfer of their know-how to a new generation. The Ministry has determined that there is a need to improve the level of safety and health in the workplace by: (1) ensuring the safety of workers; (2) improving the health of workers; and (3) promoting the creation of comfortable work environments. To this end, the Ministry has prescribed a series of PDCA (plan, do, check, and act) activities, and it provides administrative guidance to encourage workplaces to adopt systems that will enable them to carry out ongoing and continuous safety and health management. The basic content of the occupational safety and health management systems (OSHMS) advocated by the Ministry of Labour is summarized in Table 4

.

15 The Amendment of the Occupational Safety and Health Law, especially with respect to the Systematic Risk Assessment of chemical substances

The Ministry of Health, Labour and Welfare, in order to respond properly to the situation mentioned-above, amended the Occupational Safety and Health Law, and enacted Article 28-2 as follows and enforced it, since April, 2006.

(Investigation, etc. to be carried out by Employer)
Article 28-2 The employer shall, as provided for by the Ordinance of the Ministry of Health,

Labour and Welfare, endeavour to investigate the danger or harm, etc., due to buildings, facilities, raw materials, gases, vapours, dust, etc., and those arising from work ions and other duties, and based on the results thereof, shall endeavour to take necessary measures to prevent danger or health impairment to workers, in addition to taking the measures provided for by the relevant orders of the Ministry of Health, Labour and Welfare.

However, the said investigation except for the one with respect to chemical substances, preparations containing chemical substances and other substances which may result in danger or health impairment to workers shall cover the employers only in the manufacturing industry and such other industries as provided for by the Ordinance of the Ministry of Health, Labour and Welfare.

2. The Minister for Health, Labour and Welfare shall make publish the necessary guidelines relating to the measures in the preceding paragraph to achieve appropriate and effective implementation thereof, in addition to those provided for in paragraphs 1 and 3 of the preceding Article.
3. The Minister of Health, Labour and Welfare may provide individual employers and organizations of employers with necessary guidance and assistance, etc., in accordance with the guidelines provided for in the preceding paragraph.

According to Article 28-2, Minister of Health, Labour and Welfare enacted and enforced since April 2006, Guidelines for Risk Assessment on Chemicals, Notification No. 2, Guidelines for Risk Assessment, March 30, 2006. This Guideline covers risk assessment and risk management with respect to not only harmful chemical substances but also dangerous chemical substances.
The Contents of the said Guideline are shown as Appendix.

These OSHMS recommendations highlight the identification of hazards and toxicants as an effective way to carry out work environment measurements.

15. Outstanding issues related to work environment control

Four main issues related to work environment control must be addressed in order to achieve further improvement in the prevention of occupational diseases. These issues are as follows.

(1) Only a little progress is being made in the fight against pneumoconiosis in Japan. We must step up our efforts in this area.
Japan's Ministry of Labour (the Ministry of Health, Labour and Welfare of Today) is currently carrying out the Campaign to Promote Implementation of Comprehensive Measures for the Prevention of Occupational Respiratory Diseases. This campaign is part of the Ministry's five-year plan, which runs from 1998 to 2002, and JISHA is lending its complete cooperation to the campaign.

(2) In addition, we must also make a concerted effort to prevent health problems stemming from exposure to chemical substances. We continue to see over 300 cases of this type occurring every year. When the Industrial Safety and Health Law was amended in May 1999, changes were made to strengthen measures to prevent workers from suffering adverse health effects stemming from exposure to toxic substances. Toward this end, the amended law now stipulates that: (1) companies must provide a material safety data sheet (MSDS) when they sell or deliver chemical substances; and (2) from April 2000, companies have to start implementing guidelines issued by the Minister of Health, Labour and Welfare concerning the proper control of toxic chemical substances that are not now covered by existing legislation.

(3) One of the areas addressed by the Ministry of Health, Labour and Welfare's OSHMS recommendations is the issue of work environment control measures. The Ministry's recommendations call upon the top leadership at companies and workplaces to place top priority on work environment control measures as an indispensable part of management strategy, and to pursue the said measures in an organized and ongoing manner. Companies and workplaces are urged to ensure that this sort of management strategy takes firm root.

(4) International exchange of technology, ideas and experiences in the field of work environment control is very important.
It was difficult for Japan to establish a work environment control system to ensure the prevention of occupational diseases in the past, and many more difficulties must be overcome in the future as we work to encourage the adoption of work environment control systems in small and medium-sized workplaces. We would very much like to hear about the ideas and experiences of other nations including ASEAN ones, so that we might be able to learn from your methods.

Appendix

Guidelines for Risk Assessment on Chemicals

Notification No. 2, Guidelines for Risk Assessment, March 30, 2006

1 Purpose

Pursuant to the provisions of Paragraph 2 of Article 28-2 of the Occupational Safety and Health Law, these Guidelines shall stipulate the basic concept and actions for assessment of risks associated with chemical substances, and preparations containing chemical substances or other materials that may cause hazards or health impairments to workers, so that measures necessary to prevent workers from being exposed to risks or hazards are appropriately and effectively implemented in each work places based on the results of such assessment, and aim to promote voluntary safety and health activities by the employer.

As part of the Guidelines for Risk Assessment (Notification No. 1, Guidelines for Risk Assessment, 2006), these Guidelines shall stipulate detailed matters related to chemical substances, etc. For the sake of convenience, these Guidelines also include matters that are stipulated in the general guidelines in an overlapped manner even if there are no detailed matters that should be specified in these Guidelines.

These Guidelines shall also be designed to address risk assessment and associated measures as stipulated in the Guidelines on Occupational Safety and Health Management Systems (Ministry of Labour Notification No. 53, 1999).

2 Scope

These Guidelines shall be applicable to all hazards inherent in work performed by workers that may arise when producing, handling, storing or transporting chemical substances, containing chemical substances preparations containing chemical substances or other materials that may cause hazards or health impairments to workers (hereinafter referred to as "chemical substances, etc.").

3 Implementation Items

The employer shall implement the following items as part of the risk assessment as well as control measures to be taken based on the results of such risk assessment (hereinafter referred to as "risk assessment and control measures").

(1) The identification of hazards and/or risks caused by chemical substances, etc.

(2) An estimation of the severity and the extent of possibility of occurrence of injuries or diseases that might be caused by hazards and/or risks from chemical substances, etc., identified in item (1) (hereinafter referred to as "risks")

(3) Setting priorities to reduce the risks estimated under item (2), and examining measures to reduce risks (hereinafter referred to as "risk reduction measures")

(4) Implementing risk reduction measures in accordance with priorities set under item (3)

4 Organizational Structure

(1) The employer shall implement risk assessment and control measures under the following organization.

(a) The employer shall have the person who supervises and manages an overall business undertaking (who assumes the highest position in a work places), such as a general safety and health manager, supervise and manage the implementation of risk assessment and control measures, etc.

(b) The employer shall have a safety supervisor, a health supervisor, etc., in a work places manage the implementation of risk assessment and control measures.

(c) The employer shall designate a person to take charge of the management of chemical substances, etc. (hereinafter referred to as a "chemical substance management officer") from among those who have the ability to appropriately manage chemical substances, etc., and have such chemical substance management officer perform technical work related to risk assessment and control measures, under the management of the safety supervisor, health supervisor, etc.

(d) The employer shall have workers participate in related activities through opportunities such as a safety and health committee, a safety committee or a health committee.

(e) In implementing risk assessment and control measures, the employer shall strive to have not only a chemical substance management officer but also other competent persons who have professional knowledge regarding chemical substances, etc., and machinery or facilities associated with chemical substances, etc., participate in such activities. As necessary, the employer shall seek participation in risk assessment by persons who are well versed in the characteristics of chemical facilities, experts such as a

production engineer, and those who have expertise in chemical substances, etc.

(2) The employer shall provide education and training programs necessary to implement risk assessment and control measures to persons designated in item (1) above.

5 Implementation Timing

(1) The employer shall implement risk assessment and control measures when work specified in "a" through "e" below is conducted.

(a) When a structure associated with chemical substances, etc., is installed, relocated, modified or dismantled

(b) When a facility associated with chemical substances, etc., is newly introduced or a change is made to a facility

(c) When raw materials that are chemical substances, etc., are newly adopted or changed

(d) When a working method or working procedures associated with chemical substances, etc., are newly adopted or changed

(e) Otherwise, when risks perceived in a work places change or are likely to change, such as in the following cases:

① If an industrial accident caused by chemical substances, etc., occurred and problems were found in the contents of risk assessment and control measures conducted in the past

② When new expertise concerning risks or hazards from chemical substances, etc., is acquired

③ Because of the elapse of a certain period after the most recent investigation, etc., when the quality of machinery, equipments, etc., associated with chemical substances, etc., have been deteriorated due to aging, when workers do not have adequate knowledge and/or experience relative to safety and health due to turnover or when new safety and health expertise is acquired

(2) The employer shall recognize that it is necessary to implement risk reduction measures before the start of work specified in "a" through "d" of item (1) above.

(3) It is also desirable for the employer to conduct risk assessment and control measures when plans relative to "a" through "d" of item (1) above are formulated.

6 Determination of target with respect to Risk Assessment and Control Measures

Based on the following considerations, the employer shall determine what work is subject to risk assessment and control measures.

(1) All risks or hazards caused by chemical substances, etc., in a work places shall be subject to risk assessment and control measures.

(2) Such works as caused, in the past, occupational accidents due to chemical substances, or incidents etc., as likely cause risk and/or health hazard due to chemical substances, shall be subject to risk assessment and control measures.

7 Collection of Information

(1) When implementing risk assessment and control measures, the employer shall gather the materials listed below and make the best use of the information contained in such materials. In gathering the materials, the actual situation of work sites shall be taken into consideration, and not only materials concerning routine work but also those related to non-routine work shall be gathered.

a. Material safety data sheets (MSDS) for chemical substances, specifications, chemical substances concerned, information concerning hazards caused by machinery, equipment, etc., associated with chemical substances, etc., and

b. Work standards, operation procedures, etc., associated with chemical substances, etc.

c. Information on the surrounding work environment such as the layout of machinery and equipment, etc., associated with chemical substances, etc.

d. The results of working environment measurements, etc.

e. Information on situations where multiple employers conduct work in one place, such as hazards caused by chemical substances, etc., arising from several kinds of operations performed in a single location

f. Actual cases of occurrences of accidents and statistics on accidents, etc.

g.. Other materials and information relevant to implementing risk assessment and control measures

(2). When gathering information, the employer shall take note of the following matters.

a. When the employer plans to acquire new chemical substances, etc., the employer shall obtain material safety data sheets (MSDS) for the relevant chemical substances, etc., from those who transfer or provide said chemical substances, etc.

b. When the employer plans to introduce new machinery, equipment, etc. associated with chemical substances, etc., from external, the employer shall require the manufacturer of such machinery, equipment, etc., to conduct risk assessment and control measures at the design and production stages of

said facility and shall obtain the results of such risk assessment and control measures.

c. When the employer plans to use or remodel machinery, equipment, etc., associated with chemical substances, etc., which is not owned by the said employer, the said employer shall obtain the results of risk assessment and control measures conducted by the person or company that owns management title over such facilities.

d. When multiple employers conduct work in one location, each employer shall obtain the results of risk assessment and control measures conducted by the master employer to prevent an industrial accident caused by chemical substances, etc., due to the performance of different types of works at one location.

e. When multiple employers conduct works in one location where risks or hazards from chemical substances, etc., exist such as where workers may be exposed to chemical substances, etc., each employer shall obtain the results of risk assessment and control measures conducted by the master employer regarding such relevant location.

8 Identification of Hazards

(1) Based on work standards, etc., the employer shall examine work in detail on units necessary to identify risks or hazards from chemical substances, etc., and shall identify hazards inherent in each work unit in accordance with the classification of hazards that is specified in the "Globally Harmonized System of Classification and Labelling of Chemicals (GHS)" published by the United Nations (hereinafter referred to as "GHS"), etc.

However, in chemical plants, etc., the employer may divide such a plant into several sections by using a method of division by a process, a method of division by layout, or other appropriate methods. Then, facilities in each section shall be made subject to risk assessment and control measures to identify hazards caused by chemical substances, etc.

(2) In identifying risks or hazards caused by chemical substances, etc., as specified in item (1), the employer shall take into consideration the additional effect of worker fatigue, etc., on risks or hazards.

9 Estimation of Risks

(1) In order to determine priorities to reduce risks, the employer shall estimate risks using a method such as those described below, taking into consideration the severity and the extent of possibility of the occurrence of injuries or diseases that may be caused by hazards from chemical substances, etc.

a. A method in which the severity of injuries or diseases and the extent of possibility of the occurrence of injuries or diseases are measured and plotted on vertical and horizontal axes, and risks are estimated by using a table in which risks are predetermined according to the severity and the degree of possibility

b. A method in which the extent of possibility of the occurrence of injuries or diseases and the severity of such injuries or diseases are numerically expressed based on prescribed criteria, and such numerals are added or multiplied to estimate the degree of risk

c. A method in which risks are estimated by separating the severity of injuries or diseases and the extent of possibility of the occurrence of injuries or diseases on a phased basis

(2) Notwithstanding the provisions in item (1), the employer may estimate risks with respect to diseases caused by chemical substances, etc., by using one of the following methods and by taking into consideration the degree of hazards of and the amount of exposure to the relevant chemical substances, etc. However, of the following two methods, the employer is encouraged to adopt the method indicated in "a."

a. A method in which a worker's exposure concentration of the chemical substance, etc., that is subject to investigation is measured and the measurement result is compared to exposure limits of the relevant chemical substance ("occupational exposure limits" published by the Japan Society for Occupational Health). If the measured exposure concentration is below such exposure limits, the relevant risks may be treated as being within the permissible range

b. A method in which the degree of hazards of the chemical substance, etc., which is subject to investigation and the level of a worker's exposure to the relevant chemical substance, etc., are measured and plotted on vertical and horizontal axes, and risks are estimated by using a table in which risks are predetermined according to the degree of hazards and the level of exposure

(3) In estimating the extent of possibility of the occurrence of injuries or diseases as specified in item (1) and exposure concentration as specified in item (2), the employer shall be aware of and make use of the following matters.

However, information indicated in "i" below shall be required only when such information is available.

a. Properties of the relevant chemical substance, etc.

b. Production or handling volume of the relevant chemical substance, etc.

c. Details of work related to the production, etc., of the relevant chemical substance, etc.

d. Working conditions for the production, etc., of the relevant chemical substance, etc., and the status of associated facilities
e. Personnel assignments to work related to the production, etc., of the relevant chemical substance, etc.
f. Working hours
g. Installation of ventilation systems
h. Utilization of personal protective equipment
i. With respect to the relevant chemical substance, etc., measurement results of concentration in the existing working environment or exposure concentration, or results of biological monitoring

（4） The employer shall estimate risks relative to chemical substances, etc., as specified in items (1) and (2) in accordance with the classification of risks or hazards specified in the GHS. During this estimation process, the employer shall consider the following matters.

a. Reliability of functions or measures to prevent industrial accidents (hereinafter referred to as "safety and health functions, etc.") such as the installation of safety devices, "off limits" measures and the installation of exhaust ventilation systems as well as the ability to maintain such functions or measures
b. Possibility of undoing or ignoring safety and health functions, etc.
c. Possibility of foreseeable intentional or accidental incorrect use or dangerous behaviour, such as deviation from work procedures or errors in handling
d. Even if the existence of a hazard is not proven, if there are reasonable grounds for suspecting a hazard, the employer shall strive to estimate risks by assuming the existence of a hazard based on such grounds

(5) In estimating risks as specified in item (1), the employer shall take note of the following matters.

a. Accurately identifying those persons who may suffer estimated injuries or diseases and the details of such injuries or diseases
b. Estimating the severity of the most serious injuries or diseases by assuming the worst possible case, rather than by using the severity of injuries or diseases that actually occurred in the past
c. Because it is desirable to use common criteria to measure the severity of injuries or diseases regardless of their type, the employer shall principally use the number of days absent, etc., due to such injuries or diseases as the measurement criteria.

10 Study and Implementation of Risk Reduction Measures

(1) The employer shall ensure that the measures required by applicable laws and ordinances are fully implemented. In addition, the employer shall study and implement measures for reducing risks in the order of priority given below.

a. Cessation of the use of high-hazard chemical substances, etc., or replacement with lower-hazard materials
b. Reduction of the extent of the possibility of the occurrence of injuries or the level of exposure such as by changing the operating conditions of chemical reaction processes and the form of chemical substances, etc., handled in a work places
c. Engineering measures such as the adoption of explosion-protected structures for machinery and equipment associated with chemical substances, etc., and double safety devices, and/or industrial hygiene engineering measures such as the enclosure of machinery and equipment associated with chemical substances, etc., and the installation of local exhaust systems, etc.
d. Administrative measures such as the preparation of instruction manuals
e. Use of personal protective equipment

（2） In studying measures as specified in item (1), the risk reduction measures to which a higher priority is given must be implemented in as much as possible, except for cases in which the burden incurred to reduce such a risk is substantially greater than the expected effect of preventing an industrial accident, leading to a significant imbalance between the cost and effect, and where the implementation of such measures is considered highly irrational.

(3) If a long time is required to implement appropriate risk reduction measures for risks that might lead to fatalities, residual disability or severe diseases, provisional measures shall immediately be taken.

11 Recording

The employer shall maintain a written record of the following activities.

（1） Investigated chemical substances, etc.
（2） Examined and identified work or process
（3） Identified hazards
（4） Estimated risks
（5） Priorities established for risk reduction measures
(6) Details of implemented risk reduction measures