Preface

The Institute of Occupational Safety and Health (IOSH) is a research institute under the jurisdiction of the Council of Labor Affairs (CLA), Executive Yuan. Its important mission include application of scientific technology, surveys and analyses of various risk factors in the working environment, as well as development of countermeasures.

This annual report is a general report of the various activities of the IOSH, commencing January 1, 1998 and ending December 31, 1998. It is divided into 4 chapters: ¡§Introduction¡¨, ¡§Focus of Research¡¨, ¡§Research and Results¡¨, and ¡§Related Activities¡¨. In addition to providing a general overview of the various businesses and activities of the IOSH for fiscal year 1998, we hope that this annual could provide the community with an understanding of IOSH. A summary of the contents for each chapter is provided below:

1. Introduction: provide a summary of this annual report, organization and personnel of IOSH and their respective responsibilities, research expenditures and research laboratory building construction project.
2. Focus of Research: provide a brief introduction of research orientation of each division of the IOSH.
3. Research and Results: provide research results of each division of IOSH, as well as a description on various research projects being implemented.
4. Related Activities: provide a list of academic and exchange activities held by IOSH, papers and presentations related to occupational safety and health, the publications of IOSH, computer/networking devices, promotion and exhibitions of IOSH¡¦s researches, assistance in occupational survey and other services.

The appendix includes a list of IOSH¡¦s technical book collections (published in 1998) and research projects from fiscal year 1998 (July 1, 1997 to June 30 1998) to fiscal year 1999 (July 1, 1998 to June 30, 1999) for reader¡¦s reference.

Director of IOSH

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Introduction

I. Overview

The Institute of Occupational Safety and Health (IOSH) was established in August 1992, over six years ago. From the beginning, the planning committee has clearly defined goals and directions of IOSH in its organizational regulation, which include:

1. Provide the theoretical basis for occupational safety and health strategies and administrative measures.

2. Provide solutions to important occupational health and safety problems.

3. Provide references for revisions of important occupational safety and health regulatory standards and management systems.

4. Upgrade the technological standard in occupational safety and health and inspection activities.

5. Provide necessary information for training and consultation in occupational safety and health.

In keeping with the spirit from the past, through open discussions and careful reviews that incorporated recommendations from various parties, IOSH has developed Research Strategy 1997-2001 to guide future research, in response to changes in industrial structure and results of national survey of occupational hazardous exposures, and in accordance with administrative needs of Departments of Labor Safety and Health and Labor Inspection, and occupational safety and health standards issued by or proposed in European Union, International Standards Organization and World Trade Organization. Research Strategy focuses on serial and interdisciplinary research, goal-oriented and comprehensive in nature, in survey of work environment and work conditions, evaluation and prevention of occupational injuries and diseases, and technology for occupational safety and health management and personal protective equipment, in order to improve safety and health in domestic work environment, awaken workers' awareness of occupational safety and health, decrease occupational injuries and prevent occupational diseases, for the ultimate end of creating safe, healthful, and comfortable work environment for the nine-million-plus workers in Taiwan.

This annual report covers research activities from January 1 to December 31 of 1998, with the completion of 96 projects for fiscal year 1998, and the initiation of 88 projects for fiscal year 1999. All results are disseminated externally through presentation of research results, technology transfer, publications, thesis, internet, on-line searches, exhibitions and various seminars and conferences. These include 94 publications (over 40,000 copies issued), 1 exhibit, 24 academic conferences, thesis presentation in 18 local and foreign publications, 29 local and foreign academic conferences. 4 projects won awards from the Executive Yuan and the National Science Council, and 8 patents are obtained or pending. IOSH also assisted with investigations in incidences of occupational injuries and diseases, as well as provided calibration services for inspection agencies.

II. Organization and Personnel

IOSH is headed by a Director, a Deputy Director and a Secretary-General. It is divided into five divisions: the Division of Occupational Safety, the Division of Occupational Hygiene, the Division of Method Development and Analysis, the Division of Occupational Medicine, and Occupational Safety and Health Exhibition Branch. For administrative support, it has a Secretarial Office, an Accounting Office, a Personnel Office and a Government Ethics Office.

1. **Organization**

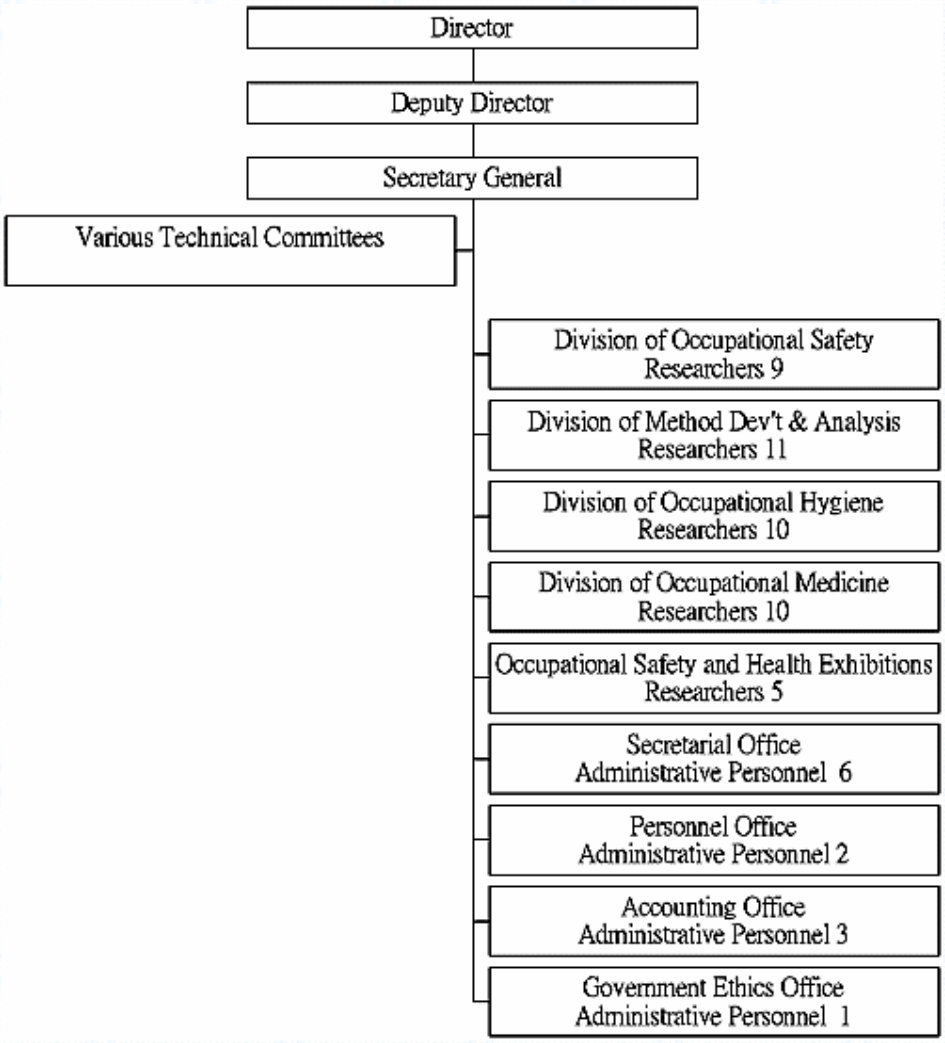


Figure 1 Organizational Structure

2. Analysis of Research Positions

Table 1 Analysis of Research Positions

Positions	Researcher	Associate Researcher	Assistant Researcher
Number of Employees	16	18	11

3. **Analysis of Level of Education of Current Research Personnel**

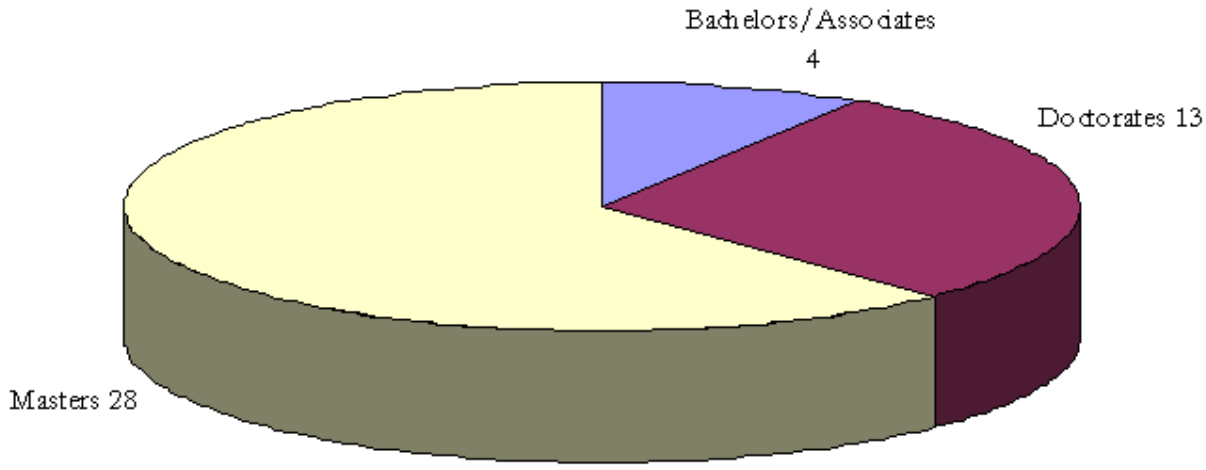


Figure 2 Analysis of Level of Education of Current Research Personnel

Note: Currently, 3 research personnel are undertaking doctorate studies.

II. Research Expenditures

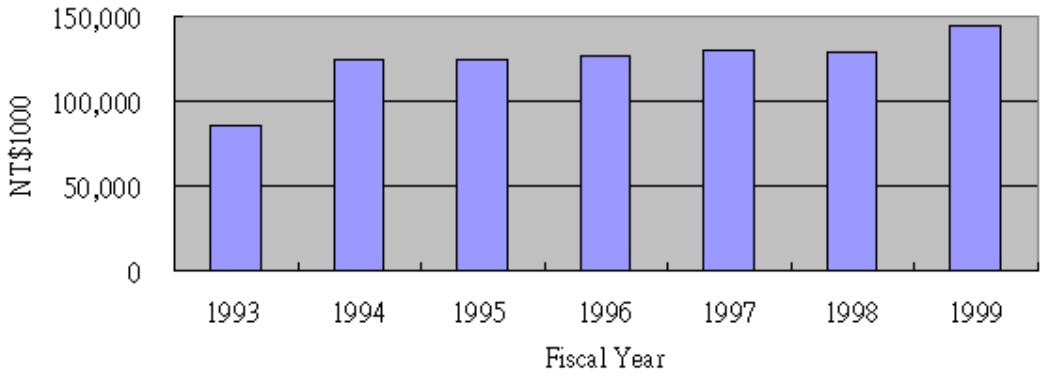
II. 1. Budget for Fiscal Years 1998 and Fiscal Year 1999

Table 2 Budget for Fiscal Year 1998 and Fiscal Year 1999

Unit: NT$1,000

Subject	Budget for FY 1998	Budget for FY 1999
Occupational Safety and Health Research	?	?
Occupational Safety Survey and Research	31,627	35,404
Method Development and Analysis Technology Research	27,349	29,986
Occupational Hygiene Survey and Research	27,710	32,531
Occupational Medicine Survey and Research	27,364	32,176
Occupational Safety and Health Exhibitions	15,137	14,916

2. Analysis of Research Expenditures Over the Years



II. Figure 3 Budget for Fiscal Years 1993 to 1999

III. .Research Laboratory Construction Project

1. Construction Plans

1. Immediately after its establishment on August 1, 1992, IOSH has embarked on a plan to construct a laboratory building. After visiting numerous sites, IOSH requested for 8.6 hectares of land located in Hsi Chih, Taipei County, from the National Property Bureau, which was subsequently approved by the Executive Yuan.

2. Pursuant to regulations provided under the ¡§Management Guidelines for Development and Construction on Hilly Terrain¡¨, construction and development of hilly terrain must be reviewed by the local government. Permission will be issued in three stages: first a permit for development on hilly terrain, second a license for miscellaneous projects (including a license for their use and an application to change the zoning in non-urban areas), third a building license (including a building permit).
3. An engineering consulting firm was commissioned to obtain permission for development in March 1993. All necessary documents were submitted to Taipei County Government, which issued a permit for development a year later in July 1994. Designs for miscellaneous projects were prepared three months later for the application of a license, which was obtained in April 1995. These projects were contracted immediately thereafter, and were completed in October 1996, despite a delay due to weather, moving of ancient graves and public protest. IOSH obtained a note certifying that no public property was damaged during the construction from Hsi Chih Government, and applied for a permit to use the miscellaneous facilities and for zoning change to ¡§land for special-purpose enterprises¡¨. These administrative procedures were completed in June, 1997.
4. Architectural design for the laboratory building was completed in September 1996. However, because the process in obtaining the permission for development in the second stage was so lengthy and ¡§Technical Regulations on Construction¡¨ was revised in the meantime, the design was modified accordingly. IOSH applied for a building license in August 1997. Approval on construction permit was subsequently obtained on October 27, 1998. Currently, construction works is being subcontracted. It is estimated that open tender shall be conducted on January 28, 1999, after which, construction works will commence. It is estimated that building construction will be completed before end of fiscal year 2000.

2. Contents of Construction

(1) Miscellaneous projects:

A. Entry/exit roadways.

B. Sewage pipelines.

C. Conservation of soil and water (drainage, retaining walls, landscape slopes).

D. Common drainage.

(2) Main buildings: total area 24,581.16 m^2, including:

A. Research and administrative offices 1893.21 m^2.

B. Laboratories 13249.07 m^2, including 8 for occupational safety, 9 for method development and analysis, 9 for occupational hygiene, and 6 for occupational medicine.

C. Exhibition hall and library 2678.8 m^2.

D. Education and training 5157.5 m^2, including an auditorium, lecture halls, conference rooms, dormitory and recreational areas.

E. Underground parking lot 1602.61 m^2.

3. Expenditures

(1) Miscellaneous projects: NT$ 46 million.

(2) Main buildings and landscape architecture: NT$ 590 million.

(3) Instruments and equipment: approved by the Executive Yuan and budgeted yearly in accordance with construction progress.

FOCUS OF RESEARCH

I. Research on Occupational Safety

Based on the operation guidelines of IOSH, occupational safety research includes projects on safety management policy, mechanical safety, chemical safety, electrical safety, construction safety, and personal protective equipment, etc.

Occupational safety research is primarily oriented towards development of technologies for safety equipment,

development of hazard monitoring and warning systems, development of hazard control and intrinsic safety technologies, formulation of regulations, standards, criteria for inspection, modification and recommendation for functions of personal safety equipment, with design for comfort, safety evaluation and management.

Focus of the various research projects of occupational safety are as follows:

1. **Research on Construction Safety**

At the present stage, construction safety is one of the most important issues of the Council of Labor Affairs in terms of prevention of occupational injuries. Emphasis of research in construction safety is not only focused on surveys of current conditions, safety management and evaluation of construction safety, but also on prevention of construction hazards, and technologies of construction safety equipment and construction methods, in order to minimize occupational hazards in the construction industries. Research in 1998 included devices to prevent collapse during excavations for pipelines and sewage systems, devices for safety of workers climbing on steel structures, means for incorporating safety considerations in planning and design, establishment of a local management system that incorporates construction safety and establishment of a construction safety technical database.

2. Research on Mechanical Safety

Analysis showed that struck by object, caught in or compressed by equipment, cuts and abrasions were the major types of injuries, which for the most part were due to unsafe machinery. Research therefore focuses on cranes, lifts, boilers and pressurized containers that often result in serious injuries, and construction machinery and process machinery that often result in caught in or compressed by equipment and cuts and abrasions. In 1998 research emphasized warning technology for robots, process machinery and construction machinery; inspection of dangerous machinery and equipment; modeling and training system for operating dangerous machinery and equipment.

3. Research on Electrical Safety

Occupational electrocution incidents are the second leading cause of serious occupational injuries. Technical guidelines for explosion-proof electrical apparatus are also lacking. Short-term objectives for prevention of electrocution include developing and improving warning and protective devices, and establishing technical guidelines for choosing protective devices. Short-term objectives for explosion-proof electrical apparatus research include technologies for classification of hazardous areas with combustible gases and vapors for explosion-proof purpose, analysis of structural specifications for explosion-proof electrical apparatus and appropriate choice of apparatus, so that plants will install suitable explosion-proof electrical apparatus and decrease the occurrence of fires and explosions.

4. Research on Chemical Safety

Focus of research includes safety and risk assessment of chemical production processes, and safety in

semiconductor manufacturing plants. Research included surveys of hazards in semiconductor manufacturing and chemical industries, control of run-away reactions, fire prevention in semiconductor manufacturing, development of risk assessment technology, models and characterization of explosive properties of chemical substances and related control technologies.

5. Research on Safety Protection Equipment

The provision of appropriate safety protection equipment is the last means to prevent injuries. Emphasis of research is on functional evaluations, comfort design and development of new safety protection equipment. A new type of helmet suitable for using both in construction sites and while riding a motorcycle was developed, in order to provide adequate protection for workers. In addition, comparison of standards for functions and fitness of safety goggles was conducted, with the development of a computerized system to support the choice of appropriate eye protection for workers, to combat the current lack of understanding in personal protection equipment.

6. Occupational Safety Management and Policies

Focus of research is primarily on analysis of trends of occupational hazards, review of regulations, evaluation of organizational functions, preventive measures to respond to potential occupational hazards. New indicators for occupational hazards, and new management technologies were developed, in order to elevate safety consciousness of employers and employees. Trends of types of occupational injuries, geographical distribution, and personal factors were reported to effectively support the enactment of policies. Feasibility of regulations (amendments), evaluation of safety management policies and organizations, and studies of the effectiveness of labor inspection were conducted in order to strengthen functions of safety management.

The primary purpose of research on occupational safety lies in the study and development of technologies to prevent occupational hazard and improve work environment and application of scientific technology. Model for research lies in: analyzing hazard factors related to safety of work environment of workers, proposing recommendations and measures to prevent occupational hazards, upgrading work environment of local workers to protect their safety, reduce rate and frequency of occupational hazards, providing a scientific theory for decisions and administrative measures for occupational safety, providing a reference for revision of regulations on occupational safety regulations and management system, and upgrading technological standards of occupational safety and inspection activities.

To unify research in the Division, meet current demands for occupational safety, and satisfy expectations of the public, research focuses on multi-disciplinary, high risk, future-oriented project series, which include fire prevention in semiconductor manufacturing, explosion prevention of mobile pressurized containers, monitoring and warning technologies for collapses during construction, overturn of construction machinery and incidences of electrocution, and comfortable design of safety protection equipment while ensuring protective functions of the equipment. The effectiveness of safety research is maximized through optimization of research resources and integration of various academic fields.

II. Research on Method Development and Analysis

Researches on Method Development and Analysis are focused on the development of monitoring methods for chemical hazards in the work environment, quality assurance and quality control programs in laboratories, development of certification for laboratories, and study of evaluation technologies for occupational exposures and health hazards. Orientation of research are as follows:

1. Develop easy-to-promote and practical sampling and analytical techniques for the environment.

2. Develop sampling media and analytical protocols applicable to local work environment.

3. Investigate actual exposure conditions for workers in high-risk industries.

4. Establish a database for the sampling and analytical methods and provide services to interested parties.
5. Conduct technology transfer of sampling and analytical methods.

According to the operational guidelines of IOSH, the functions of the Division of Method Development and Analysis are to establish sampling and analytical methods for environmental monitoring and biological monitoring methods, to assist in identifying occupational diseases through exposure assessment, and to evaluate the performance of the commercially available sampling equipment with the goals of improvement and development. Currently, emphases of research are as follows:

1. Survey on chemical exposure

There are still cases of occupational diseases caused by different chemical hazardous factors present in the working environment today. The government has adopted various positive strategies to seek improvement measures to express its concern on this matter. However, there is no way to understand actual occupational exposures, since no comprehensive survey on exposures to various highly dangerous chemicals in the work environment has been undertaken. The lack of reference information has created difficulties in the formulation of labor policies and the amendment of regulatory standards. To solve this shortcoming, there is a need to design and implement a series of organized researches on occupational exposures, and to integrate these results with other exposure monitoring data and the surveillance systems for occupational diseases. These will allow for the formulation of more thorough and feasible policies and regulations. IOSH shall continue to conduct in-depth studies of highly hazardous substances used in large quantities in industries, with large numbers of exposed workers or high incidence of occupational diseases, which are also focus of labor inspection and subjects for the setting of regulatory standards.

2. Development of sampling and analysis techniques for hazardous substances in the work environment

The Council of Labor Affairs amended the "Permissible Exposure Limits of Hazardous Substances in the Work Environment" in 1995. More than 200 different kinds of hazardous materials were included and permissible exposure Limits were substantially lowered. In conjunction with these amendments, IOSH is actively developing standards for

sampling and analysis of the newly included hazardous materials. Taking into account the special environmental conditions, and analytical techniques employed in developed foreign countries, methods for local sampling and analysis have already been established over the years. An Environmental Assessment Technical Committee was also convened to review various validated analytical methods, before submission to the Council of Labor Affairs for promulgation. Emphasis of research for this fiscal year shall continue to focus on the establishment of techniques for sampling and analysis of various hazardous materials, as well as further studies on newly developed sampling and analysis technology such as thermal desorption. The establishment of a database for method development and analysis will provide inquiry services to governmental agencies, academic research institutes, and enterprises to conduct various hazard surveys, and to obtain information on local occupational exposures and health hazards.

3. Development and evaluation of samplers and sampling media

Currently, most of the sampling equipment used in method analysis is imported from foreign countries. Not only are these equipment expensive, but also not necessarily suitable for work environment in Taiwan, which is characterized by high temperature and high humidity. Developing local samplers and sampling media that are more economical, more convenient, and more accurate, is needed. A personal sampler for mist and small-diameter aerosol was developed this year to better evaluate actual conditions of occupational exposure.

4. Development of biological monitoring techniques

It is essential to develop biological monitoring techniques to supplement environmental monitoring, since environmental monitoring only considers inhalation exposures. Many industrial raw materials or process intermediates may also enter the human body through dermal contact and ingestion. In addition, differences in personal hygiene and inter-individual variability in skin absorption also increase the need for biological monitoring. Biological monitoring is the direct acquisition of a biological specimen from the human body, such as blood or urine, to test for the internal dose of hazardous substances or their metabolites. It also takes into account factors such as skin absorption, ingestion, work load, physical conditions, personal hygiene habits, and use of protection equipment to evaluate occupational health hazards. In recent years, research on occupational health technologies has caught the attention of developed countries in the world. In light of the above, IOSH invited scholars from various disciplines to form a Biological Monitoring Technical Committee, which determined that priority should be given to blood lead required in current occupational health examination regulations, and biological monitoring of eight organic solvents required by Japanese government. In 1998, research on biological monitoring focuses on development of biological monitoring technologies for mercury and investigation on quality of laboratories for analyzing lead in blood.

5. Development of real-time gas monitors

Due to difficulties in using current sampling and analytical methods for certain substances in certain industries, the Division of Method Development and Analysis conducted a study on the functions of direct reading monitors. Also, an assessment on the properties of some detector tubes sold in the market was conducted. A technical manual on use

and selection of detector tubes was also written.

Recently, Fourier transform infrared spectroscopy (FTIR) has become common for real-time gas monitoring. The Division of Method Development and Analysis conduct an evaluation on application of this particular instrument on industrial hygiene, and has found that it is very effective in monitoring hazard exposure in semiconductor manufacturing. For fiscal year 1998, this instrument has been effectively applied in the evaluation and survey of occupational exposure in semiconductor industries and maintenance operations.

III. Research on Occupational Hygiene

Occupational hygiene studies means for understanding and controlling risk factors in the work environment. According to operation guidelines of IOSH, the Division of Occupational Hygiene is responsible for research relating to occupational health management policies, surveys and prevention of chemical, physical, biological and ergonomic hazards, and measuring instruments and protection equipment related to occupational health. At this stage, the Division of Occupational Hygiene is oriented toward prevention of occupational diseases. In line with these guidelines, it has formulated four basic concepts and research objectives:

1. Understand occupational exposure levels in the work environment.
2. Study control measures to resolve occupational health problems in enterprises.
3. Obtain important local data on occupational hygiene, and
4. Cooperate in establishing regulations and policies in occupational hygiene.

Research is directed to:

1. Study the work environment in which occupational diseases have occurred, in order to understand occupational exposure levels of various risk factors, and to develop control measures;
2. Support and promote systems necessary for the establishment of occupational safety and health regulatory system, and assist enterprises in finding solutions to difficulties encountered;
3. Obtain important local data in occupational hygiene, to provide references for regulatory amendments and improvements in the work environment;
4. Introduce technologies to prevent possible occurrence of major occupational diseases;
5. Provide research results to the Council of Labor Affairs, to serve as a reference for amendment of regulations.

Due to limited manpower and fund, the Division of Occupational Hygiene, combining domestic and Institute research resources, focuses on exposure assessment, risk prevention and management policies of important occupational hazards.

Considering specialties of research personnel and availability of local resources, the Division of Occupational Hygiene combines local and relevant IOSH resources and actively conduct survey on exposure to significant occupational hazards, as well as formulate hazard control and management policies. In line with available research personnel and

local resources, and to establish research characteristics for this Division, focuses of research are as follows: 1. survey of exposure to occupational hazards; 2. prediction models and control of hazardous substances and noise; 3. occupational health protection equipment and measuring apparatus; 4.evaluation and control of ergonomic hazards; 5. control of occupational musculoskeletal injuries. Objectives and methods are described as follows:

1. Survey of exposure to occupational hazards

With rapid economic development and diversification of industrial operations, risk factors in the work environment are more complex and difficult to understand than ever. In order to reduce occupational injuries and to protect health of workers, there is a need to study hazardous exposure conditions and levels, and numbers of workers exposed, so that regulatory priority for chemical substances and industries can be determined for the formulation of strategies in occupational safety and health and in labor inspections.

2. Prediction models and control of hazardous substances and noise

Results from a study on status of safety and health conditions in the work environment among workers in the Taiwan Area, conducted by IOSH in 1995, showed that workers believed that improvement was most needed for pollution of hazardous substances and noise in the work environment. To lessen air pollution in the work environment, ventilation equipment is commonly adopted. However, with the complicated nature of airflow, improper ventilation design may at times produce exactly the opposite effect. Noise has a very significant effect on health and work efficiency of workers.

Emphasis of research lies in the development of control technologies for airborne hazardous substances and noise in order to improve the work environment. It also emphasized the development of relevant estimation models, to be validated in the field by labor inspectors and industrial hygienists, in order to understand possible effects of engineering control measures, so as to avoid making mistakes in installation, and to increase incentives to enterprises to improve the work environment. Research results can also be used to construct theories on controlling airborne contaminants and noise in specific industries.

3. Occupational health protection equipment and measuring apparatus

Occupational health protection equipment is the last line of defense in a workplace. Deficient or inappropriate use of health protection equipment will harm health and life of workers. Environmental assessment and control of conditions and hazard factors in the work environment are dependent on accuracy and quality of measuring apparatus. Studies focus on standards and technologies for testing of protection equipment, as well as their appropriate use and necessary education, and calibration of measuring apparatus (including photometers, noise meters, and anemometers). Effects of high humidity, high temperature, and facial shapes on protective effect and willingness to use are also important to consider.

4. Evaluation and control of ergonomic hazards

Ergonomics is an applied science aimed at understanding the interaction between human abilities and environmental factors. Its objectives lie in the promotion of safety and health, efficiency and comfort at work. The lack of proper safety and man-machine interface design in machinery and equipment, and poor work environment can easily cause occupational injuries. Studies on causes of occupational injuries showed the lack of overall coordination between work methods, equipment, environment and "the worker". At the present stage, ergonomic research emphasizes applications of anthropometric data, assessment of manual material handling, introduction and dissemination of international ergonomic checklists, prevention of ergonomic injuries in the workplace, and adaptation of heat environmental models to local conditions. Hopefully through the application of ergonomic principles, occupational safety and health problems may be resolved, as well as elevating work efficiency and comfort of the work environment.

5. Control of occupational musculoskeletal injuries

In recent years, with changing industrial structure, increasing repetitiveness of work, and using machinery not matching physical dimensions of local workers, occupational musculoskeletal injuries are becoming more serious. According to a survey on safety and health conditions in the work environment in Taiwan in 1991, 51.8% of workers complained of awkward work posture. In a similar survey conducted by IOSH in 1994, 38 out of 100 workers reported muscular pain and soreness, of which 79% believed it was work-related, revealing that preventing musculoskeletal injuries is an important research topic.

At this stage, research emphasizes safety and health guidelines for designing man-machine interface, preventive strategy for repetitive injuries, physiological measurements related to biomechanics and support devices to prevent musculoskeletal injuries, so that occurrence of occupational musculoskeletal injuries will decrease.

IV. Research on Occupational Medicine

Research on Occupational Medicine is related to the study of various occupational factors and health hazards, as well as the prevention of occupational diseases, to further protect and promote the health of workers. In accordance with guidelines provided by IOSH, the responsibility of the Division of Occupational Medicine includes epidemiological study on occupational diseases, prevention of occupational diseases, health management, labor health promotion, and research on occupational psychology and physiology. Primary research orientation is focused on monitoring occupational diseases and analyzing health data, epidemiological study on occupational diseases, prevention of occupational diseases, labor health promotion, and occupational biological monitoring. Emphases of research are as follows:

1. Monitoring of occupational diseases and analyzing health data:

1. A comprehensive database is a basis for research work. In formulating research orientation and legal policies, there is a need to rely on native databank. However, reporting system on Taiwan occupational diseases is still in its initial stages. Due to low occupational disease reported cases are very low, it lacks a comprehensive

Taiwan database. Thus, in addition to actively designing reporting system for occupational diseases, collects information from various channels, monitor and analyze occupational diseases and labor health data, as well as establish a database for labor health and occupational diseases. Research hopes to find high-risk industries to provide a reference for the formulation of prevention strategies for occupational diseases and serve as a basis for formulation of safety and health laws and policies.

For fiscal year 1998, primary source of monitoring data is derived from data on compensation for labor insurance, data on prevention of occupational diseases and health inspection, health inspection data of sanitary workers and hospitalized data from labor insurance due to occupational injuries and illnesses. It also established standard for epidemiological studies and compared it with population information. Based on above information, conduct diversified analysis and study to provide a basis for amendment of policies and laws and serve as a preliminary study for epidemiological research. In terms of occupational disease monitoring system, establish a reporting system for occupational hearing loss, medical surveillance on acute occupational injuries in emergency rooms, monitor occupational burn injuries and monitor occupational decompression sickness for compressed air workers. At the same time, establish labor-hearing threshold.

2.

Survey on Occupational Diseases and Occupational Epidemiology Research:

Due to rapid industrial and commercial development in Taiwan in recent years, complex production technologies and various new chemical substances have continually been applied in work place. Workers are exposed to more and more complex working environment, leading to emergence of various occupational diseases. Thus, the purposes of this research lie in survey on occupational diseases to gain an understanding on the current situation of occupational diseases, establish various epidemilogical data on occupational diseases, study hazard factors derived from epidemiology research to formulate measures to prevent occupational diseases and as relevant research for policies and regulatory requirements. In addition to chemical hazard factors, research emphasis is also focused on new emerging occupational diseases and physical hazard factors.

In 1995, IOSH established a ¡§Occupational Disease Identify Committee¡¨ to assist in resolving disputes on occupational diseases. However, the cause-effect relationships of occupational diseases are difficult to identify. In addition to theoretical basis, it should be supplemented by a survey on epidemiology study to serve as a standard for establishing occupational diseases. Thus, the study on identification technology and theories for occupational diseases is one of the emphasis of research.

For fiscal year 1998, primary research include vinyl chloride exposure, sulfuric acid exposure, isocyanates exposure, foamed resin industry, coal miners, pneumoconiosis, noise exposure (automobile manufacturers, textile industry), fishing industry, semi-conductor industry, transport industry, exposure to 1,3-butadine, animal husbandry, medical health promotion service industries, operations of dental technicians, epidemilogical study

among RCA employees and pesticide manufacturing industry. In addition, there were hazard assessment on occupational bladder cancer, hazard assessment and preventive measures on abuse of drug substance, and survey on sudden death syndrome among workers. In addition to chemical hazards, scope of research also include new emerging topics such as pains on neck and shoulders, psychedelic and occupational cancer.

3.

Research on Labor Health Promotion:

Occupational hygiene is not only concerned with the prevention of occupational diseases and occupational hazards but also active promotion of health, safety and comfortable working environment. To maintain health conditions, and promote health and delay aging process of workers physiologically and psychologically, research emphasis includes both physiological and psychological aspects. It conducted a multi-faceted research on worker¡¦s health to protect the physical and mental health of workers as well as promote labor¡¦s health.

The research includes health promotion strategy among aging workers (service industry, manufacturing industry, construction industry), assessment on work fatigue and physiological conditions of workers (high elevation operation, telecommunication operation), survey on dietary pattern and nutrition status of workers, study on basic information on metabolism, development of information system for evaluating occupational pressure, study on suicide among workers, and study on health management practices in work place. At the same time, set up a model for the establishment of rehabilitation network for the physically disabled workers.

4. Occupational Biological Monitoring:

Chemical hazards enter the human body through various routes. Thus, there is a need to monitor the hazardous materials inside the human body through biological medicine technology to serve as workers¡¦ health hazard biological monitor index. Thus, through the application of biomedical technologies, conducted biological monitoring index research, as well as conducted an epidemiological study on hazard factors and metabolic mechanism to achieve early detection and early prevention, and serve as a reference for permissible exposure limit.

Research emphasis for fiscal year 1999 is focused on research relating to immunopathogesis, which includes study and analysis of HLA genes of TDI sensitive workers, synthesis and detection about protein conjugates of chemical allergen, and study on biological indicators for heavy metal (chromium, cadmium) exposure.

Research and Results

I. Research on Occupational Safety

Since its establishment on August 1, 1992, the Division of Occupational Safety has actively considered and

repeatedly modified its research directions, integrating results of discussions on "Development of Occupational Safety and Health Technologies" in the Scientific and Technology Consultative Meetings in fiscal years 1994 to 1997. As recommended by Consultative Committees, research projects for fiscal year 1998 shall be based on research strategies designed for the next 5 years and a continuation of project foundation between 1994 to 1997. Research was conducted in areas concerning mechanical safety, chemical safety, electrical safety, construction safety, safety protection equipment and safety management and policies.

1. **Mechanical Safety:**

Research is primarily focused on the development of surveillance mechanism and analysis on hazards of dangerous machinery and equipment.

Completed ¡§Preliminary Evaluation on Detailed Design, Manufacture and Technology Transfer of Hydraulic Brake Failure Warning Mechanism in Construction Trucks¡¨ (see Figure 4). Detailed design and modification on prototype of brake failure warning mechanism was conducted, especially those relating to various sensor devices, signal processing circuit and signal receiver controller. Efforts were geared towards increasing the stability and reliability of the warning mechanism. At the same time, the mechanism was further improved and simplified. The warning mechanism will also include an automatic water sprinkler control function. This method will prevent loss of braking capability due to high temperature. Also, a mechanism to observe imbalances in brake pressure will be added to study warning and surveillance of imbalances in brake power of left and right wheel.

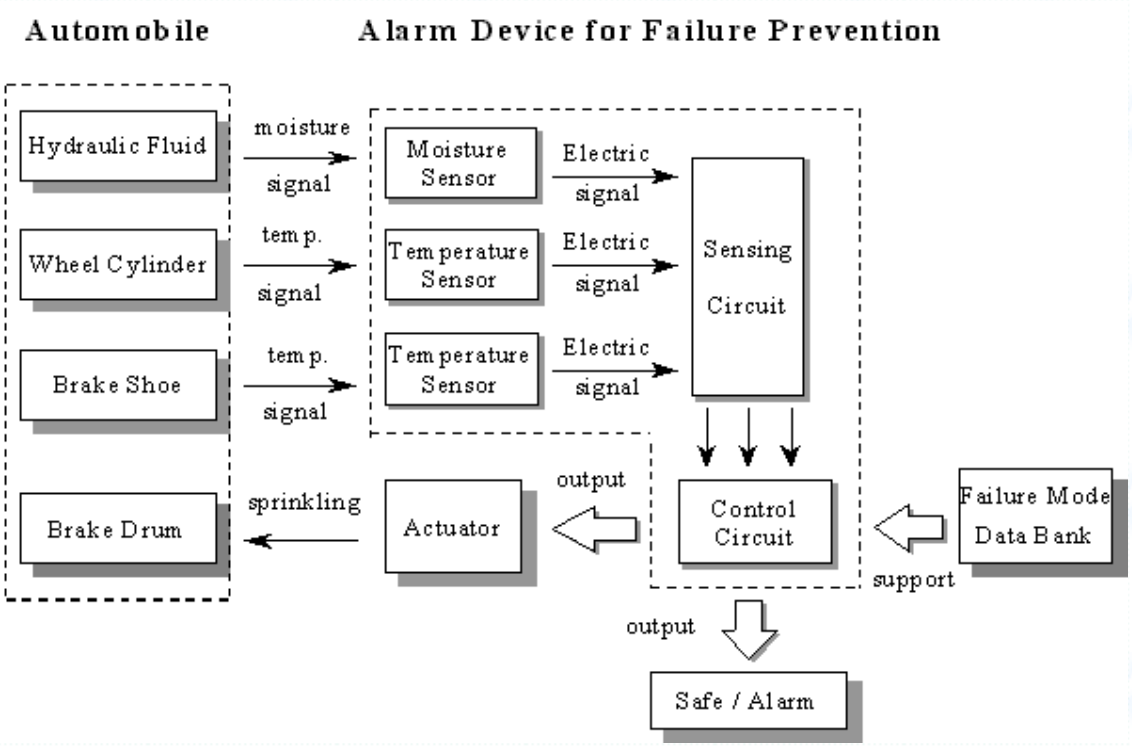


Figure 4 Structure of Hydraulic Brake Failure Safety Warning System

Completed ¡§Development of Simulation Systems for Training of Dangerous Machinery and Equipment - Mobile and Stationary Cranes¡¨. Developed a virtual reality training system for crane operations. Objective of this project lies in strengthening the ability of trainees to operate cranes safely and to strengthen their ability to respond to emergency situations, as well as improve and substitute a large section of traditional training methods. In terms of operations, cranes can be divided into mobile cranes and stationary cranes. Virtual reality simulation system for cranes includes training on relevant documents to obtain license, design of virtual reality scenario, application of virtual reality installation, design of hydraulic platform and locomotion platform, development of surveillance system and multi-media production. A comprehensive system integration was conducted. In short, this is a considerably comprehensive simulation system package.

Completed ¡§Development of Hazard Preventive Techniques for Major Hydraulic Machinery ¡V Fan, Compressor and Pump (II)¡¨. Established a set of on-line real-time failure warning system and technology for hydraulic machinery. Research emphasis was focused on the development of a set of systematic, on-line, real time failure diagnosis technology and hardware prototype, including comparison and software development on methods of diagnosis systems, software development of digital signal processor (DSP), production of prototype for diagnosis system and application actual tests (including fans, compressors, pumps) etc. This could provide the industrial community with a comprehensive set of failure diagnosis system and system prototype for hydraulic machinery, to serve as an important reference on how to reduce maintenance cost, and increase service life of equipment and industrial safety.

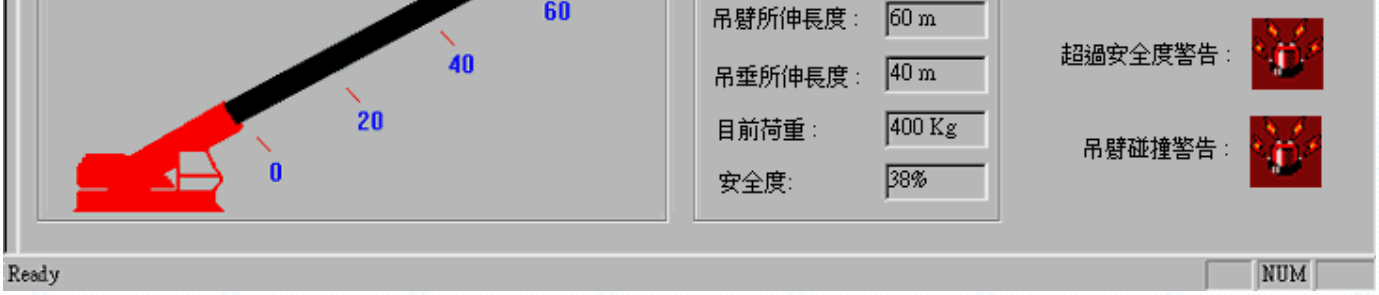


Figure 5 Control Dialog Box for Mobile Cranes

Completed ¡§Risk Assessment and Prevention for Cranes ¡V Mobile¡¨ (see Figure 5). For truck cranes, the fault model effects and fault tree analysis were used to classify factors for errors and failure so as to establish the effect of component failure on hazard model. It developed a basic structure for safety awareness and applied this in safety systems of mobile crane to establish a technology for safety confirmation. Also, it also formulated safety indicators for inspection purposes on safety and hazard of mobile cranes in coordination with relevant standards and regulations and propose improvement recommendations to prevent incidents.

Completed ¡§Designing and Manufacturing a Commercial Model of a Overturn Warning Device for Forklift¡¨. A forklift mathematical model was deduced by studying the causes of overturning forklifts. After simplifying model, we applied hardware - 8051 single chip to make microprocessor single panel, A/D panel, voice warning system, signal warning system and produce a low-cost, circuit effective warning testing panel. It can conduct actual test and vehicle parameter analysis on forklifts, and overturn danger indicator RPER (dynamic overturn critical value) calculations. Finally, a commercial prototype of warning device was completed. Through technology transfer, this device can be widely installed in forklifts.

Completed ¡§Design of Overloading Prevention Device for Mobile Cranes and Preliminary Study for Technology Transfer¡¨. The study has deducted truck cranes and ordinary cranes torque equations and control equations, and developed a weight level sensor. Signals obtained from the length, rotating angle and level sensors were transmitted to 8051 central algorithm device. The stability of cranes was therefore determined. At the same time, output signals allowed crane to respond adequately. In addition to stress on product function on all overload warning device development process, we require low cost and hope to increase the number of the owners in the industries who are willing to use this device, and therefore, reduce occupational hazards due to overloading.

Completed ¡§Design of Over Winding Prevention Device for Mobile Cranes and Preliminary Study for Technology Transfer¡¨. Through this study, we could understand the shortcomings and inconveniences of using over winding warning devices. Innovated warning devices not only operate normally, but also meet requirements of relevant laws. This over-winding warning device has the laboratory test, and verified its high reliability and usefulness. It has also passed property test and durability test. The cost of this new device is far lower than the cost of other products in the market, which is beneficial to consumers. Automatic prevention of hazard control allows continuous operation within safety range and improve the inconveniences of complete lock. Patent is currently pending.

Completed ¡§A Study of Safety Technology for Construction Elevators (II)¡¨. We have collected and analyzed local and foreign methods of construction elevators strength calculations and establish construction elevators structural strength calculation standards. A structural strength inspection standard for local construction elevator was

established for manufacturers and reviewers to follow. As there is no local standard for calculation of strength of rack and pinion construction elevators, this project provides a reference for the amendment of relevant strength calculation standard and inspecting organizations to conduct review of structural strength calculations.

Completed ¡§Structural Analysis and Safety Standard for Aerial Lift.¡¨ Finite element method and mechanism kinematics analyses were used to conduct computer simulation analysis of stability and structural strength of aerial lift. We have conducted stability test of aerial lift and validate analytical results. Recommendations for the enactment of domestic regulations for aerial lifts was proposed, which can be used as a reference for inspection standards, and reference to relevant government authorities for formulation of various management and regulations of aerial lifts.

Completed ¡§A Study of Trends of International Standards for Cranes¡¨. The analysis on international standard and trends for cranes was completed. Recommendations for amendment and revisions of local standards for cranes, which includes inspection of cranes, safe use, test procedures, safe installation, stability requirements, were drafted. To strengthen various domestic standards for cranes and coordinate with international trends, the project studied standard amendment principles and priorities for cranes as a reference for domestic regulatory amendment for cranes. Also, it provided a reference to the National Standard Bureau for amendment of national standards for cranes and a basis for the Council of Labor Affairs (CLA) to amend or revise inspection standards.

2. **Chemical Safety**

2. Completed ¡§Performance Evaluation of Flame Arresters for Vehicles¡¨. Through different production processes, gas and vapor explosion test were conducted. Different explosion class and different flame gaps tests were also conducted to confirm the selection of the specifications of flame arresters. The study allowed the relevant government authority to have a basis for formulating relevant standard and business enterprises to understand how to select flame arresters.

   Completed ¡§Technology for Storing Peroxides¡¨. We used adiabatic calorimeters to study the decomposition process of methyl ethyl ketone peroxide during storage. Established the decomposition reaction temperature, pressure elevation data and safety condition of storage. Also, relevant U.S. regulations were collected as a reference for relevant government authorities and a basis for business enterprises in design and specification of storing peroxides.

   Completed ¡§Study on Digitized Electrochemical Chlorine Sensor¡¨. In this research, conductive polymer polyaniline was used to make electrode of sensing elements to improve chlorine sensor and assembly of prototype sensor was completed. Patents application for use of highly conductive polymers as electrode materials for sensor elements is currently underway.

   Completed ¡§Study on Management Guidelines for Special Gases¡¨. The research collected relevant information such as Japanese ¡§Self-Inspection Standard for Prevention of Hazards from Special Material and

Gases¡¨ and NFPA318, SEMI F Standard, SEMI S Guidelines, FM 7-7 of U.S.A. A comparison among relevant regulations in Japan, USA and Taiwan was then conducted. The research also drafted a ¡§Safety Standard for Prevention of Hazard from Special Gases¡¨ to manage special gases used in semiconductor factories. It serves as a reference for relevant government authority in the formulation of laws and regulations and a reference to industries for designing and purchasing of relevant facilities. At the same time, it has proposed guidelines on important items mentioned in the draft.

3. **Construction Safety**

Completed ¡§Techniques to Prevent Trench Cave-in Fatalities (II)¡¨. This research designed and produced retaining wall protective facilities. This protective facility is installed in pipe-connection works in ditches to protect the construction workers. For fiscal year 1998, completed projects include patent application of protective facility for both wheel type and movable type retaining wall (Pending patents 8610091.Rp and 8610092.RP), production of wheel type retaining wall protective facility, development of standard of assembly procedures, standard operating procedures (SOP), restrictions on use, and equipment maintenance. Also, it has conducted dynamic tests on collapse of wheel type retaining wall protective facility. Results revealed that strength of this facility is better but weight is heavier, thus operation in ditch is not easy. Based on these test results, this project redesigned and produced another kind of improved wheel type wall retaining protection facility (Figure 6) and conducted collapse test. Test results revealed that this facility is easy to operate and meet strength requirements.

Figure 6 Illustration of Wheel Type Sewage Excavation Retaining Wall Structure

Completed ¡§Safety Device for Erecting and Climbing Steel Structures¡¨. The objective of this project lies in the manufacture of safety device for erecting and climbing structures. This device protects the workers during steel structure assembly operations and welding operations. In addition to understanding actual work methods and procedures of on-site workers, we analyzed causes of hazards during assembly process and prevention feasibility. Dynamic analysis was used to design a safe, economical, convenient to suspend, easy to dismantle and assemble climbing structure and work table for welding operations. After evaluation of various designs, the best project was selected for production and test. A manual was written to describe installation, assembly, applicable conditions and restrictions.

Completed ¡§Safety Considerations to be Included in Building Engineering Planning and Design" Currently, most safety management are concentrated on the construction phase. However, occupational construction hazard and environmental factors are related. Environmental factors are related partly to design phase and partly to construction phase. Thus, the responsibility of construction safety management does not lie only on business enterprises during construction stage but also on the designers in the planning phase. Thus, with concept of Total Safety Management, TSM, there is a need to provide a norm for construction safety during the design stage to enhance management efficiency. In coordination with construction safety management during the construction stage, this research

established considerations for construction safety of entire construction to reduce occupational construction hazards. The spirits behind ¡§Labor Safety and Health Law¡¨ , ¡§Enforcement Rules for Labor Safety and Health, and ¡§Guidelines for Review and Inspection of Hazardous Work Environment¡¨ were implemented, and feasibility of including civil construction plans and designs on construction safety is being formulated.

Completed three volumes of ¡§Technical Handbook for Construction Safety¡¨. Despite the numerous number of construction works going on in Taiwan, potential construction hazards have been neglected. Training materials related to safety are lacking, leading to mounting numbers of construction hazards. In accordance with regulations provided under Article 23 of the ¡§Labor Safety and Health Law¡¨, the employer should provide workers with necessary safety and health education to prevent hazards. IOSH plans to formulate various technical safety manuals on various construction works to serve as educational materials for related designers, construction workers and owners. This will serve to increase risk awareness of relevant personnel and protect the safety of workers. For fiscal year 1998, technical handbooks relating to construction safety, namely ¡§Concrete Engineering Safety¡¨, ¡§Erection, Welding and Lifting Tasks in Steel Construction¡¨ and ¡§Foundation Engineering Safety¡¨, have been completed.

5. **Electrical Safety**

5. The research area focuses on improvement and selection of protective mechanism to prevent electrocution, selection of explosion-proof electrical apparatus, classification of hazardous work place.

   Completed ¡§Improvement of Electric Shock Prevention Devices for Arc Welding Machines¡¨. Experiments conducted on measurement, simulation analysis and actual use of automatic arc welding machines revealed that most domestically produced automatic arc welding machines meet international standards and has no big difference when compared with Japanese automatic arc welding machines. Site interviews revealed that the primary reasons for interference includes poor quality of products, poor quality control, poor waterproof qualities, and high internal temperature which led to high failure rate. Improper usage was also one of the reasons which allowed welding machine output circuit resistance too high or start-up sensing resistance selection of automatic arc welding machines to be too low, causing difficulties in arc welding. To provide for comprehensive protection, primary power source side of welders should be equipped with a circuit breaker, casing and object should be properly grounded. Also, insulating sheath of commercial alternate welder are not comprehensive and needs further improvement. Finally, a standard operation procedure for welding machines and an automatic inspection checklist was proposed.

   Completed ¡§Classification of Hazardous Areas in Ignitable Gas and Vapor Atmosphere¡¨. Conducted a comparison on the differences that exists between foreign reputable documents API, IEC, NEC, IP and relevant local standards. Use 3D current field computer dispersion analysis simulation software to simulate and analyze the status of leaks and dispersion in 8 primary production processes equipment: pump, release and inspection equipment, compressor, ventilation outlet, pipeline system, external overflow basis, open basis, pollution storage basis. Three factories were selected to verify the results. Relevant factories and scholars were invited

to a seminar to understand the response of the industrial community and its suitability. Finally, a manual was written on classification of hazardous areas in ignitable gas and vapor atmosphere to serve as a reference for industrial community and inspectorates.

Completed ¡§Selection and Installation of Flame Proof Enclosures and Increased Safety of Electrical Apparatus for Explosive Gas Atmosphere.¡¨ A study was conducted a study on use, place, temperature grade, environmental conditions, assembly, inspection, maintenance and other matters relating to selection of flame proof enclosures and increased safety of electrical apparatus for explosive gas atmosphere. Completed selection and assembly technologies for flame proof enclosures and increased safety of electrical apparatus for explosive gas atmosphere. Provide a reference to labor inspectorates and local business work place for selection of flameproof enclosures and increased safety of electrical apparatus for explosive gas atmosphere to prevent fire explosion accidents.

Completed ¡§A Guide for Selection and Installation of Earth Leakage Circuit Breaker to Prevent Electric Shock¡¨. Currently, selection of earth leakage circuit breaker is primarily regulated under Regulations for Indoor Circuit Installations and Regulation for Labor Safety and Health Facilities. However, it is not as detailed as Japanese Standard for Electrical Equipment Technology and Regulation on Labor Safety and Health. Thus, this study will establish a guidelines for selection and techniques for earth leak circuit breakers based on types, place of use, selection, assembly, inspection, maintenance and other relevant items. This technical guideline will provide labor inspectorates and business enterprises with the technology on selection, assembly standards, repair and maintenance techniques of earth leak circuit breaker for different circuits and equipment so as to enhance functions of earth leak circuit breaker and reduce electrocution accidents.

6.

Research on Personal Protection Equipment

This research area focused on function tests, comfortable designs, development and improvement of personal protection equipment.

Completed ¡§Commercial Design of Industrial Helmet and Motorcycle Helmet¡¨. Research was focused on designing a light weight safety helmet with efficient heat dispersion and one-piece accessory. It was easy to assemble and it was able to meet the impact requirement of both industrial and motorcycle helmet. We have designed the shape of this new helmet and completed injection model analysis and property tests. The goal was to commercialize this innovated helmet.

Completed ¡§Designing Comfortable Protective Glasses¡¨. Research was primarily focused on providing comfortable protective glasses to workers. Interviews for customers¡¦ requirement was conducted together with the establishment of functions and specifications, and the analysis on protective glasses in the market and related patents. The factors that affect the comfort when wearing glasses were conducted. Experiments were also conducted to study these

factors, such as visual experiments, fog experiments on glasses, ventilation tests, material analysis, and facial pressure tests. Based on these experiments, along with a comprehensive design procedure, the discomfort of wearing glasses could be reduced.

7. **Research on Safety Management and Policies**

Research is primarily focused on studies of coordination organizations in construction industries and prevention of traffic accidents.

Completed ¡§Establishment and Evaluation of Coordination Organizations in Construction Industries.¡¨ The construction industries have the highest rate of serious occupational hazards. Most of the injured workers worked for contractors. A coordination organization is responsible for cooperation and communication both horizontally and vertically among all the enterprises working in the same site. And business enterprises have been unable to establish an effective and appropriate management operation model for a coordination organization. This has resulted to a high rate of occupational incidents. In light of the above, the project formulated a standard structure of coordinating organization for construction industries. This will allow mutual assistance, cooperation among business enterprises which are working together and effectively reduce rate of occupational incidents such as collapse in construction industries. Recommendations in operations of coordinating organizations in construction industries were proposed.

Completed ¡§Research of Strategies to Prevent Workers from Traffic Accidents¡¨. In addition to a search for factors of high incidence rate of traffic accidents among workers, it provided recommendations regarding these factors to business enterprises, government authorities and research institutes. Results of research can be used as training materials for occupational safety and health courses and a reference for traffic safety education. In the future, the importance of traffic safety would be carried by conference to business enterprises. Business enterprises could use suggested remediation measures and training and educational information on traffic safety to their workers.

In general, special features of research projects in fiscal year 1998 were as follows: active development of hazard monitoring and warning technologies, proposal of new studies to respond to safety problems brought by automation and changes in industrial structure; study of safety management systems for temporary structures, and emphasis on the development of safety protection equipment. In addition to these projects, other activities regarding occupational safety carried in fiscal year 1998 included: participating in investigations of major occupational incidents with inspection agencies, cooperating and communicating with local and foreign academic organizations, convening conferences on research results and other safety issues, calibrating safety measurement instruments used by labor inspection agencies, and planning for the laboratory building.

Research projects in occupational safety for fiscal year 1999 will meet administrative demands of the labor inspection agencies, Department of Labor Safety and Health, and the Department of Labor Inspection. Also, in accordance with short-term, mid-term and long-term goals recommended by consultative committees and research strategies plans for

the next five years, research area will be categorized to mechanical safety, chemical safety, electrical safety, construction safety, safety protection equipment, and safety management policies.

1. **Research on Mechanical Safety**

1. Focuses on the development of monitoring and warning devices, hazard analysis of dangerous machinery and equipment, and development of simulation systems for training. It includes ¡§Vibration Suppression of Tower Crane Maneuvers & Altitude Control of Its Payload¡¨, ¡§Investigation in Fail Safe for Hydraulic Power Systems of Machinery ¡V Crane¡¨, ¡§Development of Simulation Training Systems for Dangerous Machinery and Equipment -- Designing the Commercial Product System of Mobile Crane and Overhead Crane¡¨, ¡§Study of Safety Coupling Device for LPG Pipe¡¨, ¡§Evaluation and Prevention of Hazards of Construction Elevators¡¨, ¡§The Development of the Inspection Technique for Corrosion Under Support of Petroleum Pipeline¡¨, ¡§Study on the Corrosion of Tubular and Plate Heat Exchangers in Petroleum Industries¡¨, ¡§The Study of Trends of International Standards in Crane (II)¡¨, ¡§The Fail-to-Safe Study on Safety Valve Device for Steam Boiler¡¨

2. **Research on Chemical Safety**

   Focuses on developing and managing chemical safety technologies and includes ¡§Control Strategy for Prevention of Explosion in Labor¡¦s Workplace ¡V Safety on LPG Tank Lorry¡¨, ¡§Establishment of Methods for Determining Explosions of Dangerous Substances and Videotape Production ¡V Dust Particles and Vapor Explosions¡¨, ¡§The Research on Pyrophoric Substance¡¨.

3. **Research on Construction Safety**

   Focuses on study on safety of temporary structures, feasibility study of incorporating construction safety into construction designs and writing safety manuals for bridge constructions, bridge foundation constructions and retaining wall excavation constructions. Includes ¡§The Study and Development of the Anchorage Systems Applied to the Temporary Structures and Safety Devices Under Construction¡¨, ¡§Safety Consideration to Be Included in Bridge Engineering Planning and Design¡¨, ¡§Research of Inspection System for Primary Temporary Structures in R.O.C.¡¨, ¡§Detailed Design of Vibration Isolated Device of Concrete Pumping Pipes¡¨, ¡§Research on Construction Methods of Formwork of Column ¡V Wall ¡V Beam - Slab System¡¨ and compilation of ¡§Technical Information for Construction Safety¡¨.

4. **Research on Electrical Safety**

Focuses on study of explosion-protected electrical apparatus and establishment of electrical safety technical guide. Includes ¡§Maintenance and Inspection Technique Research for Flame Proof Electrical Apparatus¡¨, ¡§The Selection

and Installation of Intrinsically Safe Explosion-protected Electrical Apparatus for Explosive Gas Atmospheres¡¨ and ¡§Compilation of Technical Information on Electrical Safety¡¨.

5. **Research on Safety Protection Equipment**

5. Focuses on designing and improving personal protective equipment, for the purpose of comfort. Includes ¡§The Detail Design and Technology Transfer of a New Eye Protector Model¡¨, ¡§The Study of Preventing Soil Collapse in Excavation Soil Retaining Walls¡¨, ¡§The Design of the Form Inspector Personal Protective Equipment¡¨.

6. **Research on Safety Management and Policies**

Includes ¡§Survey of Current Safety Status of Large Size (Employees Over One Hundred) Industrial Enterprises¡¨, ¡§A Study of the Contract Management Practice and Management Regulations in Current Construction Industry¡¨ and ¡§Study on the Culture Differences on Occupational Health and Safety Between Local and Foreign Owned Companies¡¨.

In summary, at the present stage, research emphasis is focused on survey of hazards in highly risky industries, development of mechanical simulation operating systems to prevent accidents, development of safety protection equipment, evaluation of the tools to prevent fire and explosions in chemical industries, and development of warning technologies.

II. Method Development and Analysis

To prevent occupational diseases, as well as to improve productivity and quality of the work environment, the objectives of research for method development and analysis are to establish assessment methods for hazardous substances found in the work environment, to develop quality assurance/control and certification of laboratories, and to assess hazardous exposures among workers.

Researches for method development and analysis for fiscal year 1998 included chemical exposures assessment, sampling and analytical techniques for hazardous substances in the work environment, development and evaluation of samplers and sampling media, and development of occupational biological monitoring techniques. In summary, projects for fiscal year 1998 were conducted in accordance with IOSH¡¦s short-term, medium-term and long-term plans and policy directives, in coordination with IOSH¡¦s research personnel and facilities. Chemical exposure in highly dangerous industries and operations among workers were studied, as well as more economical, convenient, sensitive, fast, automated, easy to promote, and practical sampling and analytical techniques. Sampling and analytical equipment and sampling media suitable for local conditions were developed to improve the technical level of industrial hygiene.

Significant methods and research results for fiscal year 1998 were as follows:

1. **Chemical Exposure Survey**

Completed ¡§Work Place Chemical Exposure Survey (1)¡¨. Conducted an exposure assessment on hazards present in work environment of tape manufacturing industries, composite materials manufacturers, refractory brick manufacturers, artificial leather manufacturers and copper foil laminate layer circuit board manufacturers to understand status of occupational exposure to health hazards in Taiwan. When conducting sampling test, attention should be paid on precautionary measures, recommendations and providing safety and health teachers with on-site practical experience. The project interviewed five work environments, and collected 2000 samples on airborne exposure concentration. Workers in tape industries are primarily exposed to such hazardous materials as toulene and ethyl acetate. For composite material manufacturers, workers are primarily exposed to styrene. For refractory brick manufacturers, workers are exposed to crystallized free silica. Workers in artificial leather manufacturing industries are exposed to dimethyl formamide (DMF) and large amount of butanone and toulene. Conducted surveys on DMF and ethylene glycol monomethyl ether based on solvents used by workers in copper foil laminate layer circuit board manufacturing industries. After analysis, data were compiled and an assessment report on occupational exposure written. Scope includes current status of occupational chemical exposure and health hazards in specially designated manufacturing industries, introduction of raw materials used and manufacturing processes, survey results of occupational exposure to chemical hazards and current status on use of personal protection equipment, original survey on occupational exposure, engineering control and administrative management. Results showed that occupational exposure of workers in some industries are higher than those allowed by labor inspection organizations. Requests have been filed to labor inspection organizations to list these companies as a priority subject for inspection and to provide technical assistance to improve their environment. Other relevant results could provide a reference for formulation of regulations and support relevant academic research. In addition, report on analysis of occupational exposure could serve as a reference to environmental testing units and business enterprises.

Completed ¡§Survey on Tetrachloroethylene Exposure in Hotel Dry Cleaning Operation¡¨. Conducted a widespread environmental survey and biological monitoring on presence of tetrachloroethylene in urine of workers working in hotel dry cleaning operations in Taipei. It was discovered that average exposure concentration of workers during work period is lower than regulated values. To prevent high concentration exposure during the machine door was opened, recommendations for management systems have been proposed.

Completed ¡§Absorption of Ethylene Glycol Monomethyl Ether Vapor on Working Clothes¡¨. Studied the absorption of 3 kinds of ethylene glycol monomethyl ether vapor of working clothes under different humidity, different material and improve current occupational exposure assessment technologies.

Completed ¡§Survey on Health Hazards of Ethylene Oxide (I)¡¨. Conducted a survey on ethylene oxide work environment, including manufacturing factories, downstream factories, disinfection in hospitals, medical equipment manufacturers to serve as a reference for follow-up study on sampling tests and analytical methods. For fiscal year

1998, the fist phase preliminary study has been completed.

Completed ¡§A Preliminary Study on Evaluation Technologies for Occupational Exposure of Workers in Pesticide Factories (I). Established types of pesticides and quantity in domestic pesticide factories, pesticide compound materials, processing factories and pesticide products. Established the status of distribution of kinds, quantity and regional distribution of pesticides produced, imported, domestically sold and exported. Established data on toxic information on domestically produced pesticides including acute oral toxicity, acute skin toxicity, acute inhalation toxicity and chronic toxicity. Established kinds and frequency of pesticide exposure of sanitary workers to serve as a basis for evaluation on occupational exposure to pesticides. Collected information on methods for analysis of pesticides. Collected information on occupational skin exposure, respiratory exposure to pesticides in work environment, biological monitoring methods, sampling methods to monitor and their selection.

Completed ¡§Study on Fume Composition from Stainless Steel Welding¡¨. Study potential hazardous fume composition in preparatory welding processes for stainless steel, various welding methods, welding materials, operating conditions, its potential hazard to health and assessment technologies for hazard.

1. **Development of Sampling and Analytical techniques for hazardous Substances in the Work Environment**

1. Focuses on developing sampling and analytical methods for hazardous substances suitable for the local work environment, to provide a reference for relevant government departments, academic research institutions and business enterprises.

   Completed ¡§Measurement of Chloromethane and Vinyl Bromide in the Workplace by Using Thermodesorption/Gas Chromatography¡¨. Thermo-desorption technology and gas chromatography were used to establish analytical methods for chloromethane and vinyl bromide. Also completed ¡§A Study of Gravimetric Method for the Analysis of Nuisance Dust from the Workplace¡¨

   Completed ¡§Study to Improve Sampling and Analysis of Airborne Toulene Diisocyanate (TDI), ethanenitrile and Carbon Disulfide¡¨ and ¡§Study on Sampling and Analytical Method for Mercury Vapor from Workplace¡¨ to improve inconveniences of current analytical method or high toxicity of desorption agents.

   Completed ¡§Analytical Method Validation of Twenty Five Hazardous Compounds¡¨ to coordinate with more than 200 listed hazardous materials of the Council of Labor Affairs and establish a standard reference for analytical methods as soon as possible.

2. **Evaluation and Development of Samplers and Sampling Media**

   Completed ¡§Study on Simultaneous Sampling of Acid Gas and Aerosol¡¨ Semi-conductor industries, electroplating industries and printed circuit board manufacturers uses sulfuric acid/hydrogen peroxide and

ammonia aqua etching solution, hydrochloric acid, nitric acid and chromic acid during production process. As a result, the air contains acid gas and particles such as SO_X, HCl, HNO_3, chromic acid. It is difficult to conduct sampling of hazardous materials with acid mist content. This research project uses porous material to fabricate personal samplers which could simultaneously collect acid gas and dust. It also conducted a study on the absorption efficiency of acid gas, absorption capacity, coated materials, extraction method and particle loss and conducted a comparison with theoretical predictions.

3. **Development of Biological Monitoring Techniques for Workers**

Completed ¡§Development of Biological Monitoring Techniques for Mercury¡¨. Use flow injection analysis method and atomic absorption spectroscopy to develop biological monitoring and analytical techniques for occupational exposure to mercury and establish biological monitoring techniques to occupational exposure to mercury of workers.

Completed ¡§Survey on Analytical Performance of Blood-Lead Testing in Taiwan¡¨ to study status of implementation of lead analysis and quality control systems of laboratories and quality of experimental data.

5. Development of Real-Time Gas Surveillance Technique

Direct-reading instruments and detector tube are fast in obtaining test results. They don¡¦t have to be sent to laboratories for analysis and no samples are needed. Thus, there is a need for these instruments in environmental testing. However, due to limitations of qualitative and quantitative ability of some direct reading instruments, some of the test data obtained are subject of doubts. Due to the speed of Fourier Transform Infrared Spectroscopy (FTIR) and its ability to detect various chemicals simultaneously, IOSH conducted the following research in terms of gas monitoring technologies:

Completed ¡§Examination of the Validation System of Direct Reading Instruments¡¨. Conducted a study on systems used in various countries. Results revealed that there are no validation systems on direct reading instruments, thus it is recommended that direct reading instruments not be used temporarily. However, recommendations on when to use direct reading instruments have been proposed.

Compiled ¡§Detector Tube Selection and Measurement Technical Book¡¨ to provide information on accurate selection of equipment.

Completed ¡§The Evaluation of Commercial Detector Tube Performance (I)¡¨. Conducted various evaluations on precision and accuracy of commercial detector tube for carbon dioxide and evaluation on the effects of interference of hydrogen sulfide on tests for carbon dioxide detector tube.

Completed ¡§The Evaluation of Toxic Gases Leaking from Process Machines in Semiconductor Industry¡¨. Conducted an evaluation on chemical hazards on machine preventive maintenance procedures of metal etching operations in

semiconductor industries to assess occupational exposure to hazardous materials of workers. A real-time monitoring method to detect gas phase chemical hazard has been established to provide technologies for machine manufacturers, regulation authorities, academic organizations and business organizations to improve work environment.

Research projects on method development and analysis for fiscal year 1998 are conducted to support the works of the Department of Labor Health and Safety and the Department of Labor Inspection in Council of Labor Affairs as well as formulated in accordance with latest foreign technologies and urgent domestic needs (such as frequency and severity of occupational injuries in recent years. In principle, research projects for fiscal year 1999 will build on the above, and taking into consideration recommendations of the Scientific and Technical Advisory Group of the Executive Yuan and Environmental and Biological Monitoring Technical Committee of IOSH. It will continue upon the foundation of research studies in the previous three years, and will focus on chemical exposure survey, development of sampling and analytical techniques for hazardous substances in the work environment, development and evaluation of samplers and sampling media, development of occupational biological monitoring techniques for workers and development of real-time gas surveillance system.

1. **Chemical Exposure Survey**

Conducted an assessment on occupational exposure to various chemical compounds in work workplaces in resin manufacturing, paint manufacturing and automobile surface coating. A total of 2000 occupational exposure data from workers will be obtained and principles for sampling strategies to be adopted in monitoring environment of three large industries will be written. To control status of occupational exposure of domestic workers in ABS plastic manufacturing industries, studies will be conducted in the correlation between concentration of occupational exposure and biological monitoring. In the industries that used silica, some production processes have conversion between crystallized free silica and non-crystallized free silica ingredients. Thus, a survey will be conducted to clarify such issues. Detergents used in restaurants may contain organic solvents. Qualitative and quantitative determination of organic solvents in the market will serve as a reference for determining potential occupational exposure to organic solvents and for personal protection equipment usage.

2. Development of Sampling and Analytical Techniques for Hazardous Substances in the Work Environment

Sampling and analytical techniques for amine compounds such as methylamine, dimethylamine, and trimethylamine has been established, in response to demands of evaluation occupational exposure in work environment of workers. Also, an appropriate method for sampling and analysis appropriate for formaldehyde, acetaldehyde, acrolein and valeraldehyde shall be developed. Also, sampling and analytical methods for EPA approved refrigerant used in artificial leather industries, ethylene oxide and pesticides will be established.

Thermal desorption is one of the important methods in environmental monitoring. IOSH introduced UK HSE Passive

Sampling Thermal Desorption Method. In work environment, compare Perkin Elmer ATD Tenax-TA passive sampling thermal desorption method with charcoal active sampling solvent desorption method. Conducted tests on organic solvents such as xylene, ethylbenzene, styrene, and n-butyl acetate used in the industrial community.

3. Development and Evaluation on Performance of Samplers and Sampling Media

Completed various performance tests on acid gas and aerosol samplers. Objective is to overcome the difficulty in simultaneous sampling of acid gas and aerosol in work environment; for application in semiconductor, battery manufacturing and electroplating industries.

Additionally, developed fibrous dust samplers and improved cyclone samplers so that it will have better fit to aerosol size select distribution standard by ISO. At the same time, effects were made to have more stringent quality control so as to upgrade the precision and accuracy of entire measuring methods.

Because of the lack of samplers meeting aerosol size-select distribution standard in the market, US-EPA PM10 samplers was used as subject for evaluation. Conducted an examination of evenness of particle sediments on downstream filter and improved diameter so that it will meet standard. At the same time, provide a satisfactory evenness on sediment particle.

4. **Development of Biological Monitoring Techniques for Workers**

Studies on analytical method for arsenic biological monitoring shall be implemented to effectively prevent occupational diseases caused by arsenic exposure in semi-conductor industries, photo-conductors, lead and copper alloy, glass equipment, log processing, pesticides, grass removal agent, rat killers manufacturing industries, Completed the development of biological monitoring technologies for methyl isobutyl ketone and validate the feasibility of actual application of this analytical method. Based on results of experiments, write a standard reference for analyzing biological monitoring standards for methyl isobutyl ketone.

Also, study on extent of absorption of ethylene glycol monomethyl ether on human skin will be conducted to upgrade technological standard of exposure evaluation.

1. **Development of Real Time Gas Surveillance Technology**

Develop a set of multi-purpose personal hazardous gas and vapor detector capable of continuous monitoring. This device shall be used to measure short time exposure limits average permissible exposure limits (STEL-PEL) and maximum ceiling value of hazardous gas at workplaces.

Established standard methods for FTIR to supplement inadequacy in current methods. Presently, many of the hazardous substances in the PEL list do not have a published standard method, thus legal permissible exposure limits cannot be actually implemented and penalized. As FTIR could simultaneously detect various substances, inspecting units as a basis for examination and serve as a measuring tool could use it by business enterprises to

conduct regular inspection.

A close-cell FTIR was used to measure leaks in ion implantation wafer manufacturing plants for a long period of time. It is hoped that results obtained from this project will be beneficial to safety and health of workers working in wafer manufacturing plants.

III. Research on Occupational Hygiene

Research on occupational hygiene focuses on prevention of occupational diseases caused by work environmental hazards, including their recognition, evaluation and control. IOSH submits research results to the Council of Labor Affairs, Executive Yuan, hoping that they will serve as references for the formulation of policies and occupational hygiene system, as well as for reviews and amendment of occupational hygiene regulations, in addition to providing occupational hygiene technology to assist enterprises to effectively improve the work environment, so realizing the objective of protecting the health of workers.

Plans for occupational health research were aimed at protecting workers¡¦ health through recognition, evaluation and control of the work environment, concentrating on surveying, preventing and controlling chemical, physical, biological, and ergonomic hazards, as well as at establishing research strengths. Research projects for occupational hygiene for fiscal year 1998 expanded on those conducted in 1997. In addition to gathering information on risk factors and biomechanical data locally, applying anthropometry and engineering control methods in the work environment, emphasis was placed on recognition, control and protection in special operations.

A total of 22 research projects were completed in fiscal year 1998, including:

1. Survey of Exposure to Occupational Hazards

Research is primarily focused on control of chemical, biological, physical hazards in work environment as well as conducted an evaluation on possible cases of occupational exposure to hazards in hospitals.

Completed ¡§Occupational Chemical Hazard Survey (II)¡¨. A site visit was conducted to collect information on occupational exposure to hazardous chemicals in Taiwan. This project was designed as a four-year study in order to evaluate all industries that are listed in the Labor Safety and Health Law. The present study was in the second-year survey. Four-year project will survey 3,569 factories, covering 308,000 workers. The survey rate of workers is 9.38%, which is higher than 1.64% conducted by the National Institute for Occupational and Safety Health of the United States in the 1980s. Exposure hazard index (EHI) and rating (EHR) to chemical hazards were established. Results of the first two years of this research revealed that, out of the 82 industries surveyed, a total of 1,841 raw materials were used of which 648 raw materials were hazardous, with 95 chemicals covered by regulations. On the other hand, there were 283 raw materials which contained dangerous substances of which 95 chemicals were covered by regulations. The highest EHI were found in painting and related manufacturing industries, refractory brick material manufacturing industries and paper pulp manufacturing industries (average EHI value is respectively 26.25, 21.32 and 7.14). The

highest EHR was found in the petroleum refining industries (HER=260.80), followed by paper pulp manufacturing (EHR value=85.69), and refractory brick manufacturer (HER=77.66). The EHR was the multiplication of EHI with the number of workers exposed. With respect to the control priorities of occupational chemical exposure, the top ten industries were selected as follows based on their EHI and EHR:

1. flame proof material manufacturing industries;
2. paper pulp manufacturing industries;
3. petroleum refining industries;
4. paints and related manufacturing industries;
5. telecommunication machinery and equipment manufacturing industries;
6. battery manufacturing industries;
7. shipping vessel and repair industries;
8. data storage and processing equipment manufacturers;
9. textile and shoe manufacturing industries;
10. miscellaneous chemical products manufacturing industries.

Completed ¡§Study on Occupational Health Issues of Health Care Facilities in Taiwan¡¨. According to the sampling strategy of stratification and clustering, 2 medical centers, 3 area hospitals, 7 local hospitals and 19 clinics were randomly selected, followed by random selection of total 800 interviewees. Seven hundred and thirty six healthcare workers were interviewed by questionnaires. Results showed that physicians in medical centers were exposed to chemicals less than the nursing personnel, while physicians in clinics were the major exposed group to chemicals. Some of the interviewees have to change their job position or even ask for leave because of the exposure of hydrogen peroxide, chemotherapy drugs and acetone. It was found those 66.4% interviewees in medical centers and 82-85% interviewees in area hospitals, local hospitals and clinics did not know the material safety data sheets. The risk of needlestick injury among resident physicians, nursing personnel, trainees and research assistants were higher than the other personnel. Only 21.71% physicians and 34.11% nursing personnel did not recap the needles. Reporting of needlestick injury was 0-27.05%. 73.96% interviewees were concerned on potential hazards from the movable X-ray instruments nearby. Low back/lumbar was recognized by all kinds of personnel in healthcare facilities as the major part of body with musculoskeletal sores and more frequent occurrence. Also, these facilities were obviously deficient of wrist belt, waist belt, and lifting support. In order to reduce the potential occupational hazards, enforcement of the education training of healthcare workers especially on the material safety data sheets, not recapping performance and reporting of needlestick injury and supply of sufficient amount of adequate protection equipment were recommended.

Completed ¡§A Study of Domestic Worker¡¦s Heat Hazard Evaluation Model¡¨. The objective is to establish a heat evaluation model in hot operation environment; to study the correlation of physiological reactions of domestic workers in hot environment and environmental parameters; to find representative indicators for physiological reactions of domestic workers exposed to heat hazard and to predict permissible exposure time by using environmental variables

and indicators of labor¡¦s physiological reactions. Established a heat hazard evaluation model and software of domestic workers in hot environment. Investigated the strength of environmental variables on impact level of risk hazards to serve as a reference for industrial community and safety and health professionals for improvement of hot working environment and control of hazards. The project used heat hazard test methods adopted by the International Standardization Organization (ISO) to measure physiological values of domestic workers such as heat metabolism, amount of perspiration, physical and mental temperature and skin temperature. It studied the applicability of ISO-7933 heat-hazard-prediction model on domestic workers to establish physiological values and evaluation models for heat hazard of domestic workers. The steps include: collection of data on status of heat hazard in hot environment in Taiwan; integrate international standards related to ISO hot environment and translate a Chinese version of evaluation standards for heat hazard; conduct tests on data relating to physiological reactions of workers exposed to heat hazard (for example: heat metabolism, amount, heart beat¡K, etc); establish heat hazard evaluation model and computer software for domestic workers in hot environment; study the applicability of ¡§ISO-7933 Computer Program for Evaluating Hot Environment¡¨ through use of environmental variables, physiological variables and effects of such factors as human race, height, skin color and physiological reactions. Research results revealed that there is still a discrepancy with actual physiological values of domestic workers when physical factors in hot environment and labor physiological values were substituted into ISO¡¦s empirical prediction values. The 2-year research has obtained prediction equations from data on physiological reactions of domestic workers (including: C_{res}, E_{res}, skin temperature, heart beat and heat metabolism). These can be used to understand the contribution of various physical factors in work environment on permissible working time. By understanding unit cost required for each improvement items and limitations of engineering control technologies estimate optimum selection to control hot working environment. If there is a need to further find permissible occupational exposure time of workers and heat hazard indicator, it is necessary to collect more physiological values on occupational exposure of domestic workers in hot environment, conduct revisions on prediction equations, and provide a reference to safety and health professionals for preventing heat hazard in work environment. Completed Chinese translations of ISO hot temperature regulations and distributed to relevant agencies and academic community. In accordance with ISO International Standard, established heat-hazard-evaluation software for hot environment. Held conferences on heat hazard prevention in hot environment, provide site safety and health professionals with a reference to estimate permissible exposure time in hot environment and a reference for arranging work shifts of workers and environmental control.

2. Prediction Models and Control of Hazardous Substances and Noise in the Work Environment

Researches focused on the proposal of prediction models and control technologies for environmental hazard using theories on industrial hygiene and practical experience. Theoretical and practical studies on local ventilation, general ventilation and noise control were conducted in this area. In addition, special topics and proposed control measures on dangerous operations in industries were studied.

Completed ¡§Safety and Health Improvement in Asbestos Work Place¡¨ The workers of Asbestos Cement Board (ACB) and Brake Lining Manufacturing industries are the major asbestos exposure groups. The eight-hour time

weight average of asbestos seems below the permissible exposure limit (PEL), 1 fiber / cc in ACB factories while nearly 20% of air sampling data over the PEL in the brake lining factories, Thus, this program focused its effort in improving the safety and health working conditions of the brake lining factories. Via walk through survey, work place monitoring, job analysis and engineering control, 12 factories were on-site assisted. Practical local ventilation designs and good safety and health practices were also compiled so as to disseminate the technology to other brake lining factories. Six factories improved their local ventilation systems, one factory restructured its layout to separate higher emission sources. All factories implemented best safety and health practices. Workplace monitoring results indicated that loading and unloading processes had the highest asbestos emissions, while the average airborne concentrations before and after improvement were 1.57 and 0.79 f/cc, respectively. Among the factories improving their engineering controls, the percentage of worker exposures over PEL decreased from 66% to 17% in loading and unloading processes. Average personal exposures were also decreased from 0.94 to 0.58 f/cc for loading process and from 1.83 to 0.75 f/cc for unloading processing. Good hygiene practices also helped to reduce area exposure concentrations from 0.50 to 0.33 f/cc. For both loading and unloading processes, 60% and 15% of personal exposure samples were over 1 PEL and between 0.5 and 1 PEL in 1995, respectively. The percentages were changed to 14% and 50% to have better working condition by this year program. Although significant improvement has been achieved, more efforts are needed to improve the work environment of brake lining manufacturing industries since the ACGIH recently lowers the threshold limit value of chrystotile from 1 f/cc to 0.5 f/cc.

Conducted ¡§A Study of the Relationship between Occupational Exposure Dose and Sound Source¡¨. The objective is to conduct a regional sampling test to estimate occupational exposure of individual workers and study the effects of properties of sound source in noisy environment on health of workers. It also used sound field simulation technology to evaluate the effects of each control project. Conducted a survey and evaluation on the status of work operation of workers, characteristics of sound source and distribution of sound field in work environment of a selected noisy factory. A regional sampling test results was used to draw a distribution diagram of sound field in the factory. In coordination with data on worker¡¦s operating activities, the amount of personal exposure was estimated and compared with measured value of dosage of exposure to find scope of tolerance of estimate. Sound field simulation technology was used to find the distribution diagram of sound field to study the effects of sound source on health of workers, and control and effects of various improvement options. Results revealed that its discrepancy coefficient is between 0.03-0.40 while sound level meter to measure sound pressure level in coordination with worker¡¦s operating time for exposure dosage estimation, variances in occupational noise exposure estimation on impact noise is relatively larger than one on intermittent noise. 95% reliance area is between -0.04-0.41 and 0.11-0.30. This technology can be used by business enterprises as a tool for designing and evaluating engineering improvements and served as a basis for administration and management by business enterprises. By using maximum and minimum sound pressure level of sound field distribution in labor operating area, the noise exposure dosage of worker could be estimated; it could provide site safety and health professionals with a preliminary estimation on status of occupational exposure. This could save time, human effort and resources needed in personal sampling and effectively reduce rate of occurrence of occupational hazard. The law regulates noise as full frequency noise, different noise characteristics have different level of injuries on hearing. If business enterprises wish to protect workers from hearing loss, it should

conduct regular tests on environment, establish a data on noise characteristics, understand properties of noise hazards, to serve as a reference for engineering improvements or policy for selection of hearing protection devices.

Completed ¡§The Performance of Air Supply and Exhaust System in Semi-Enclosed Working Spaces¡¨. Research was focused on the study of mutual effects of ventilation mechanism in work environment and interior airflow. Initially, a study was conducted on the optimum design for overall air exchanges and found an optimum hazard control using minimum amount of resources. This could serve as a preliminary theoretical basis for improvement of ventilation systems in medical institutions, semi-conductor industries and offices, a reference for work environment to formulate relevant regulations to control hazardous substances in work environment or relevant technologies for standard facilities, as well as provide business enterprises with a ventilation design capable of achieving maximum protection with the least cost, increase willingness of business enterprises to improve and upgrade application of resources. Research results obtained on optimization of overall exchange system has been presented in article in the Institute of Occupational Safety and Health Journal, Vol. 6, No. 1. It has also been verbally reported in the 1998 Aerosol Conference of the R.O.C. Research results have also been promoted to the academic community. The development of airflow network model into window application program can be used by technicians or designers. Research results on the model have been promoted to safety and health professionals and technicians in the Workshops on Research Results of Industrial Ventilation.

Completed ¡§A Study on Particulate Capture Efficiency by the Hood¡¨. Research focused on the particulate capture performance by the hood and relevant regulations of Labor Safety and Health Law on control velocity. A simulation program was developed for follow-up research and education. Research results have already been published in the Institute of Occupational of Safety and Health Journal Vol. 5 No. 4, Vol. 6 No. 3 and Vol. 6 No. 4 and presented verbally in the 1998 Aerosol Conference of the R.O.C. and Conference on Mechanical Engineering. The simulation program has been promoted to safety and health professionals, and technicians in workshop on Research Results of Industrial Ventilation. Follow-up research has been designed and will focus on the capture performance of hoods with a variety of shapes.

Completed ¡§Study on the Condition and the Dispersion of Chromium Acid Mist in Electroplating Plants¡¨. Research is focused on the hazard caused by chromic acid mist in electroplating plants. Tests on chromium mists particles and status of distribution were conducted to understand potential hazards of chromium acid mist in electroplating plants. The control measurement of acid mists in work environment was also under study. Results revealed that during the electroplating process, the chromium-plating tank would create large amount of chromium acid mists. Concentration at edge of electroplating tank (maximum concentration reached as high as 8 times the permissible emission level) is far higher than ordinary worker¡¦s operating area (1/20 of permissible emission level). Concentration will also change along with height. The lower the height, the higher is the concentration. The mass median diameter of the acid mist was found to be between 10-20 micron. The concentration obtained by personal sampling was found to be situated between those measured at the edge of the tank and at operating area, but both were smaller than PEL. The particle diameter was larger for higher exposure, the mass median diameter was also between 10-20 micron. By checking

time-varying characteristics of the particle diameter, the hazard was found to occur near the edge of electroplating tank. Therefore, we recommended that workers¡¦ activities should be avoided during the early and final stages of electroplating process, otherwise, the effective personal protection equipment should be used. Based on the concepts obtained in this study, business enterprises should prevent exceedingly high liquid surface in electroplating tank, employ side draft local exhaust ventilation and cover liquid surface to enclose the mist.

Completed ¡§Study on Processes and Dust Exposure in Fire Brick Manufacturing¡¨. This study is to measure the concentrations of airborne respirable particulate and the contents of crystalline free silica in bulk samples in refractory brick industry. The results indicate that quartz, tridymite and cristobalite are found in bulk samples and materials. Refractory brick workers may be exposed to tridymite and cristobalite. The contents of free silica in refractory bricks are as following sequences: pyrophylite > fireclay brick > high alumina brick > mullite brick > magnesite-chrome brick and magnesia-carbon brick. The concentrations of airborne particulate in operation processes are as following sequences: proportioning > crushing > mixing > molding > drying > burning. The respirable dust concentrations are between non-detectable to 1.1 mg / m^3 and all below the regulation of airborne concentrations.

3. Study of Occupational Hygiene Protection Equipment and Measuring Instruments:

Researches focus on factors which may affect the performance of labor safety and health protection equipment, formulation of a domestic test specifications and technologies, and calibration of labor safety and health measuring apparatus of inspection organizations.

Completed ¡§Study on Valid Respirators for Harmful Materials¡¨. Based on current status of work environment and occupational exposure, by considering functions of the respiratory protection equipment, relevant regulations in various countries and the results of panel discussion among experts, a study was conducted on the effectiveness of respiratory protection equipment. This study proposed a feasible selection philosophy for respiratory protection equipment, to serve as a reference for inspectorates and business enterprises and enhance the protection effects of respiratory protection equipment. In order to establish protection factor, the leakage ratio for different face pieces were proposed as follows: 1. ordinary face (depressurized) full mask (1%), half mask (5%), 1/4 face mask(including disposable) (10%); 2. Powered respiratory protection equipment (positive pressure, PAPR) tight-fitting face pieices (0.01%) closely attached to face (0.01%), hood (0.1%), loose fitting face pieces other than hood (2%). It also recommended that top quality filter material should be used against carcinogen. The research also conducted a study on respiratory protection equipment in special work environment, including the operations related to chromium acid, stearate, asbestos, lead and medical services. Research results were presented on newsletter and promoted to inspectorates and business enterprises for futher application.

Completed ¡§The Study for Respirator Fit Testing Standards ¡V The Effects of Dead Volume and Respiration Valve¡¨. Foreign companies mostly manufacture the respirators used by workers in Taiwan. The respirator testing procedure and standard is based on foreigner¡¦s facial shapes. Since Chinese face shapes are different much from foreigner¡¦s, the respirator is usually not fitting enough on the face and therefore, respirator leakage happens when the workers

wear the respirators. Since half-face piece respirators are used most frequently by workers in Taiwan, the effect of the respirator leakage were evaluated. The dead volume effect that is attributed to different worker facial shape was studied. The dead volume were measured to be 155, 178 and 215 cm^3 when the largest mannequin supplied by IOSH wore the A, B, C company¡¦s respirators, respectively, and the respirator leakage decreased with the increased dead volume. At the same time, the distance from leak hole to sampling point was also affecting the testing value of leakage. The effect of leakage caused by different respirator valve was also evaluated. The result showed that the leakage were very low for the three companies¡¦ respirator valve selected in this study. Furthermore, the different flow rate in respirator was also affecting the leakage of the respirator, so we change the flow rate of inhalation and studied the change of respirator leakage. The results indicated that the leakage decreased as the flow rate increased and the extent of leakage decreased was dependent upon the respirator type and worker¡¦s facial shape.

Completed regular calibration of labor safety and health apparatus of labor inspectorates. Conducted calibration on labor safety and health apparatus of labor inspectorates used feasible calibration systems and technologies for apparatus to ensure precision and accuracy of apparatus, effectively reflect status of working environment, and provide a reference for improvement on inspection works and work environment. For fiscal year 1998, calibration works on 71 photometer, 126 audiometry, 1 wind tunnel and 30 anemometer has been completed.

4. **Evaluation and Control of Ergonomic Hazards:**

The research focused on review of foreign documents and current conditions of local work environment, application of anthropometric data of domestic workers and relevant ergonomic information, study of countermeasures to resolve ergonomic problems in local work environment. The objective of study is to prevent ergonomic-related hazards, increase work efficiency and improve comfort in work environment.

Completed ¡§Design Guidelines on Safe and Healthy Man-Machine Interface ¡V A Study of Computer Simulation of Human Modeling¡¨. In this study, the computer simulation systems on human modeling in the literature were reviewed and compared, and a system was constructed including system framework, functions of each required modes, input/output modes, and demonstration. The human model developed in the study was made by 14 rigid body segments and built according to the domestic anthropometric data. The safety height of fences and the safety distance of electric devices were demonstrated in the study. Four circumstances were shown in the system: lean forward, lean backward, reaching upward, and reaching over protective structures. In order to calculate and estimate the simulation, the static biomechanical model was derived and the European Standard EN 294 was referred in the study.

Completed "A Feasibility Study on Lifting Aids for Manual Handling Tasks". The objective of the research is to conduct a survey on domestic downstream distribution industries, manual handling methods, tools and effort -saving methods, as well as conducted a study on tools and its effort saving methods. Also, it conducted a study on the feasibility of developing a effort-saving lifting aids. Studies revealed that most workers engaged in manual handling works complained of low back pains. Recently, 57% of workers in manual handling operations have suffered

musculoskeletal disorders within the last week. In terms of methods for manual handling, ratio on lift is highest. Each lifting weight is mostly 20 - 50kg. More than half of the workers in manual handling operations believed that one should possessed special skills. Otherwise, it would be relatively easy to get hurt. Manual handling tasks relied on experience. With respect to auxiliary protection equipment in manual handling tasks, although 81% of workers in manual handling jobs use auxiliary protection equipment, a large portion of these protection equipment have little effect on protection or relieving load on lower backs. Currently, most of the auxiliary protection equipment for manual handling tasks have limited effects on reducing efforts in push or pull operations and is unable to reduce lifting loads. It is recommended that future development of auxiliary protection equipment for manual lifting operations be directed towards standing posture, lifting range between 60 to 90 cm, weight between 20 to 50 kg, so as to develop an auxiliary protection equipment that could save effort, and protect lower back.

Completed "The Study of the Range of Motion of Upper Limbs in Machinery Safety". In this study, a motion analysis system was applied to measure range of motion of the upper limbs for 95th?ile of male height. In addition, a human simulated system of links was developed and used for determining the range of motion of upper limbs. It was shown that the human simulated system of links was not consistent with the real data measured due to the lack of domestic anthropometric data. The experimental measurements showed that the height of reaching upwards is about 230 cm. Compared with the foreign data, the measurements of reaching over protective structures, reaching round, reaching through opening obtained were different. However, the tendency of the measurements was the same. It is suggested that the weight of the measurements may be added under the consideration of industrial safety for the requirements of work site and environment.

Completed "The Study of Occupational Safety and Health Hazards in Semiconductor Manufacturing Industry - Comparison of SEMI Safety Guidelines and Domestic Regulation". Semiconductor manufacturing industry has been thought of as a ¡§clean¡¨ or ¡§light¡¨ industry. However, behind the attractive landscaping and architecture of these plants lie chemical-intensive processes and exotic machinery, in the use of which the potential for illness and injury is high. Semiconductor manufacturing is unique in the relatively large number and variety of hazards and the relatively high toxicity of compounds routinely handled by employees. These modern manufacturing processes are complex, rapidly changing, and difficult for those outside the industry to understand. Clear, useful information for the health practitioner is often lost in engineering complexities, competing risks and industry secrets. The purpose of this study is to conduct an overview of SEMI safety standards, and compare it with domestic occupational safety and health related regulations. The conclusion shall be submitted to the Science Park Administration and enterprises as references.

Completed "The Study of European Standards on Ergonomic". There were five ergonomics topics prepared and discussed in this study: (1)ergonomic principles relating to work systems, (2)ergonomic principles relating to mental workload; (3)manual handling; (4)ergonomics of the human-system interaction; (5)ergonomics of the physical environment. The standards included were listed and their contents, significance, the philosophy of standard making were described in the study. In addition, the European Directives on Machinery Safety relating to ergonomics were

introduced as well. Discussions were made concerning the concepts of ergonomics on standardization and some issues occurred currently such as limited number of expert ergonomists, more researches on ergonomics, the need of collaboration internationally. Some suggestions were also made to IOSH for the future work on ergonomic researchers.

Completed ¡§Mechanism of Supports of Back Belts in the Sitting Posture (I)¡¨. The objective of this research lies in understanding the types and effects of back belts and assesses its impact on sitting posture. Results revealed that belts can be divided into two groups: belt that support the waist and belts that supports the pelvic region. There are many types of back belts for waist. Based on support form and materials, it can be divided into 7 kinds. Currently, there are evidences supporting the positive and negative effects on the use of belts, of which research on limitations on range of motion is comparatively more consistent. In this research, the motion analysis systems and X-ray photography were used to analyze the effects on lumbar curvature and external joint angles in a static posture. The results indicated that different postures have a significant influence on changes in angle of lumbar curvature and joint angles. At the same time, there are significant differences between subjects. In terms of changes in lumbar vertebral and pelvic angles, the belts will allow low back to be straighter and limit pelvic activities. Thus, these belts may not be appropriate for sitting posture.

Completed ¡§A Study on the Suitability of Ergonomic Checklist for Semiconductor Manufacturing Industry¡¨. The purpose of this project is to evaluate the characteristics of MSDs checklist (developed by NIOSH). In this project, these analyses were performed by plant employees following 36 hours ergonomics training program that included practice in checklist use. The revision of checklist for domestic use was studied by field test. In addition, results generated by the checklist were generally in agreement with results generated by the questionnaire analyses. Results generated in the whole plant sensitive were 0.473, it was found that MSDs checklist was lower sensitive for identifying potentially harmful postures than last year project ¡§The Study on the Suitability of Ergonomic Checklist for Work Site¡¨, where worker were exposed to cyclical jobs. On the other hand, it is necessary to change ergonomics training program for adaptation of plant employees to use checklist. However, MSDs checklist is a primary evaluation tool. It is hoped that worker¡¦s musculoloskeletal injury problems due to improper working postures can accordingly be reduced.

5. Control of Occupational Musculoskeletal Diseases

Researches focus on the investigation of occupational musculoskeletal diseases in Taiwan, establishment of basic data for hand force exertion and physiological measurements of musculoskeletal systems, and the application of biomechanical principles, man-machine safety and health design and specifications. The results can be provided as a reference for control of occupational musculoskeletal diseases to the industrial community.

Completed ¡§Ergonomic Designs of Tools for Painters¡¨. The objective of this research lies in improving work tools of painters to meet ergonomic principles and reduce body load of workers. To achieve this objective, research started with the design and manufacture of a set of pillows to reduce pressure on neck and paint brush (two) to reduce bad

posture and load on wrist, and an extended rod for roller paint brush used in high and low elevation operations, based on ergonomic theories and principles. Current test results revealed that the new paint brush visibly improve posture. Patents for this new type of paint brush is currently under review and will be promoted for use to painters.

Completed ¡§An Investigation of Parameters of the Biomechanical Model ¡V the Establishment of the Anthropometric data of Musculoskeletal System (II)¡¨. The anthropometric data of the mass distribution, center of mass and moment of inertia of each segment in a fifteen-linkage human body for external force model has been studied last year. In this project, the data of cross-sectional areas, lines of force action, and moment arms of the lumbar tissues for the internal force model were collected. Furthermore, educational version software of the developed 3-D biomechanical model was designed. A study of the maximal object wieght of manual lifting during different lifting heights (full height, shoulder height, elbow height, knuckle height and mid lower height), different hand distances (full hand distance and half hand distance) and different twisting angles (0 degrees, 45 degrees, 90 degrees, 135 degrees, and 180 degrees) will also be included. The educational version of the biomechanical model was developed in a 3-D static model. The maximal object weights of manual lifting were calculated and compared with the results from HSE. It was found that both results were significantly different. The possible reasons might be the results in this study were computed simply from the viewpoint of biomechanics and the application of AL value from NIOSH lifting guide.

Completed ¡§Strategy of Repetitive Disorders Prevention ¡V Field Study and Establishment of Hand Force Database (II)¡¨. The objective of this research was to establish a database on hand forces of local workers to serve as a basis for the formulation of guide and design of hand tools. An instrument for measuring hand force exertion having a diameter of 3 cm, 5 cm and 7 cm was used to measure the maximum hand force exertion value in 3 basic motions: extension, neutral-position and flexion position. At the same time, a comparison with a span-type instrument for measuring hand force exertion available in the market was conducted. Wrist torque was used to measure 3 motion models: flexion/extension, radial deviation/ulnar deviation and forward rotations/backward rotations, various positive and negative wrist force torques of wrist angles. Results revealed that hand force exertion of cylindrical instrument for measuring hand force exertion is greater than those of span-type instrument for measuring hand force. In terms of motion of hand force exertion, hand force exertion in neutral position produced the highest exertion, followed by the stretched posture and bending posture smallest. In terms of diameter of hand force exertion, the hand force exertion value of a 5 cm diameter is highest. Smallest hand force exertion value was found in a 3 cm diameter. Hand force exertion of males were greater than female. The establishment of a Correlation Diagram Between Frequency of Hand Force Exertion and Permissible Hand Force Exertion was based on these maximum hand force exertion value. Hand force exertion value nearest to 75% hand force exertion value obtained from 7 subjects were used as Maximum Permissible Limit (MPL) while hand force exertion value nearest to 25% of hand force exertion obtained from 7 subjects were used as Action Limits (AL) . Under a frequency of once / minute and 5 times / minute, find the permissible hand force exertion value for 30 minutes of continuous work to establish a correlation diagram between hand force exertion frequency and permissible hand force exertion. Based on the above-mentioned maximum contraction hand force exertion of wrists database and based on information obtained above, establish a correlation diagram between hand force exertion frequency and permissible hand force exertion for 30 minutes of hand force

exertion. The former can be used as a reference for design hand tools, while the latter can be used as a specification for work.

Completed ¡§Analysis and Improvement of Low Back Pains Problems for Building Construction Workers¡¨. The OWAS methodology was applied to analyze the working postures of construction workers in this study to identify the working postures and corresponding operations having risk of musculoskeletal injuries. Ten kinds of subjects were included: steel assemblers, concrete workers, mold workers, scaffold workers, plumbers, structural steel workers, painters, masons, crane operators and carpenters. Four video cassettes (90 minutes for each) were recorded at least at two different sites for each type of workers. The tapes were then played back in the laboratory and paused for every 30 seconds to code the posture of segments. Four Action Categories (AC) of the posture were determined. The results showed that the operations that need immediate correction (AC4) were found in all operation except crane work.

In summary, research projects for occupational hygiene for fiscal year 1998 were focused on evaluation and control of airborne hazards and studies on ergonomics. It also established a local database on occupational safety and health to control emerging hazard factors, studied countermeasures for special hazards and conducted relevant research on health protection equipment. In addition to promoting research projects, studies on occupational hygiene include the organization of other activities related to occupational hygiene. These included convening presentation of research results, cooperation and exchange among local and foreign experts and scholars, sponsoring and participating in academic research on occupational hygiene, presenting research results in international academic publications, as well as actively promoting research results on occupational hygiene.

Research projects for fiscal year 1999 supports administration demands of related organizations such as the Department of Occupational Safety and Health, the Department of Labor Inspection and various labor inspection agencies. Projects also take into consideration past research findings, such as problems arising from occupational hygiene, conditions of the work environment and difficulties in implementing improvements for occupational health. In accordance with research strategic plan, as well as reviewing and continuing research from the last five years, adjustments have been made for 19 research projects in 1999, hoping that the implementation of these projects will actually meet the basic needs in occupational hygiene. Emphasis of research is stated below:

1. **Survey of Exposure to Occupational Hazards**

1. Focuses on studying severity and number of exposed workers for various chemical hazards, and recognize exposure conditions in domestic work environment, especially in industries newly covered by the ¡§Occupational Safety and Health Act¡¨, .to serve as a basis for the formulation of significant policies for occupational safety and health and a reference for occupational safety and health inspection works. Projects include: ¡§Occupational Chemical Hazard Survey (III)¡¨, ¡§Survey of Employee¡¦s Perceptions of Safety and Health in the Work Environment¡¨, ¡§Surveillance and Management of Needle Stick Injury in Health Care Workers¡¨, ¡§The Evaluation and Application of Heat Exposure Assessment Model Used in Taiwan¡¨, and

¡§Evaluation of Fungi Exposure Among Onion Workers in Southern Taiwan¡¨.

2. **Prediction Models and Control of Hazardous Substances and Noise in the Work Environment**

Focuses on solving problems associated with airborne contaminants and abnormal temperature through studies of engineering control technology, especially ventilation, and on assisting enterprises in applying it in highly hazardous workplace to improve condition of work environment. Projects include: ¡§The Study on the Hazard Evaluation and Control ¡V The Crossdraft on the Hood Capture¡¨, ¡§Safety and Health Improvement in Lead Work Place¡¨, Study on Particle Size in Refractory Brick Manufacturing¡¨, and ¡§The Study of Local Ventilation System in Semi-conductor Factories¡¨

3. **Study of Occupational Hygiene Protection Equipment and Measuring Instruments**

Focuses on factors influencing effects of protective equipment to understand factors affecting the effectiveness of occupational safety and health protection equipment, provide business enterprises and inspection organizations a reference for use of occupational safety and health protection equipment and measuring apparatus and prevent disputes on labor inspection. Thus, it has designed ¡§Evaluation of Filter Test Requirements¡¨ and has continued to design calibration of occupational safety and health measuring apparatus.

4. **Evaluation and Control of Ergonomic Hazards**

4. Focuses on applying ergonomic technologies in occupational safety and health, to avoid injuries resulting from improper man-machine interface and work environment, introduction and promotion of checklist for local work environment, evaluation on manual material handling and study on prevention of ergonomic hazards. Projects include: ¡§Design Guidelines on Safety and Health Man-Machine Interface: The Study of Computer Simulation on Working Space¡¨, ¡§An Anthropometric Evaluation on Semiconductor Manufacturing Equipment¡¨, ¡§The Ergonomic Study on Personal Lifting Aids for Trucking Task¡¨, ¡§Biomechanical Evaluation of Belt on Lifting Tasks¡¨ and ¡§The Study of Human Body Measurements for Access Opening: EN547¡¨.

5. **Control of Occupational Musculoskeletal Diseases**

To resolve increasing incidence of occupational musculoskeletal diseases, there is a need to analyze epidemiological data on occupational musculoskeletal diseases in Taiwan, collect basic data on wrist force and relevant anthropometric data on musculoskeletal systems, applied biomechanic theories to provide a norm for safety and health designs for ergonomic engineering. Research projects include ¡§Biomechanical Evaluation and Application Study ¡V Apply Biomechanical Model of Low Back Injury in Field Improvement¡¨, ¡§An Ergonomic Development for VDT Work Station¡¨, and ¡§The Improvement of Wire Tying of Pipeline Task on Construction Sites¡¨

In summary, research projects for fiscal year 1999 continue to build upon the establishment of a local database on new environmental hazards, the application of engineering control and health and management technologies to improve work environment of workers, and proposal of concepts of application of occupational health protection equipment. Meanwhile, a study on local evaluation technology and improvement technologies for new ergonomic hazards, especially in terms of improvement of man-machine interface and prevention of musculoskeletal diseases, has been conducted.

IV. Research on Occupational Medicine

Research on occupational medicine is focused on the prevention of occupational diseases and the promotion of health of workers. Research results are used as a reference for formulation of policies for occupational medicine, formulation of systems for promotion of health of workers and formulation of relevant laws. At the same time, research results are used as a reference by business enterprises for prevention of occupational diseases so as to protect the health of workers

For fiscal year 1998, studies in occupational medicine were conducted in the following four areas: occupational diseases surveillance and health examination data analysis, epidemiology studies and prevention of occupational diseases, labor health promotion, and occupational bio-medicine. Significant research results for each area are described below:

1. **Surveys on Occupational Injuries And Analysis of Health Data**

1. Primary source of data for research in occupational medicine for fiscal year 1998 was based on data on compensation for labor insurance, health examination data of workers to prevent occupational diseases, and hospitalized data from workers admitted due to occupational diseases. Statistical analysis was then conducted on chronic and acute occupational diseases, occupational skin diseases, occupational musculoskeletal diseases, occupational respiratory diseases, occupational cancer and occupational psychological diseases.

   Completed ¡§Medical Surveillance for Occupational Injuries in Emergency Rooms (II)¡¨. Collected cases of acute occupational injuries from hospitals. Established a monitoring system for acute occupational injuries analyzed and studied factors and trends relating to occupational diseases so as to formulate preventive measures.

   Completed ¡§An Analysis of Occupational Injuries and Illnesses from Hospitalized Data of Labor Insurance.¡¨ Basic information and status of injuries and illnesses obtained from hospitalized data from labor insurance were utilized to analyze age groups, sex, occupation, seniority, occupational diseases and time trends of hospitalized workers admitted due to skin diseases, musculoskeletal diseases and respiratory diseases. A 10-year database of hospitalized workers due to skin diseases, musculoskeletal diseases and respiratory diseases was established to serve as a reference for priorities in prevention for occupational diseases. Rate of hospitalization due to skin diseases, musculoskeletal disease and respiratory diseases of workers engaged in agriculture,

forestry and fishing industry is highest at 0.36, 3.09 and 1.96% respectively. Admitted cases due to skin diseases and respiratory diseases increase with increase in age. Those admitted for musculoskeletal diseases are mostly workers within the age group of below 24 years and above 40 years old.

Completed ¡§Analysis of Labor Insurance Compensation Data ¡V Sanitary Services¡¨. From 1994 to 1996, types of occupational diseases and injuries, degree of disability, age of death, sex, causes for accidents, media, injured area, approved payment, age classification, sex, causes of injuries (type of accidents), classification of diseases and injuries, numbers of days hospitalized, total expenses obtained from data on labor insurance compensation and hospitalized data from labor insurance of workers in sanitary services were analyzed. The purpose is to study occupational health hazards in sanitary services and to propose directions for prevention and strategies. From 1993 to 1996, 693 cases out of the total labor insurance compensation (including deaths, disability, injuries)and 291 out of the total data obtained from hospitalized cases came from workers engaged in sanitary services.

Completed ¡§Analysis of Psychological Disturbance Among Taiwan¡¦s Workers from 1992-1997¡¨. Analysis on labor insurance data between 1991 to 1997 were conducted to analyze the cumulative number of psychological diseases, industrial classification, types of injuries and diseases, and time trends of psychological disturbance for each year. This was done to assess trends and qualities of psychological disturbance of workers in Taiwan so as to understand the change of psychological diseases among workers. Data on labor cash payments between 1993 to 1996 showed that there were 7534 cases due to psychological disturbance. Each hold 0.0088, 0.0098, 0.0079 and 0.0055 of the total number of payments dues to occupational diseases for each respective year. Of the total number of payments due to psychological disturbance, the number of male and female workers is 4262 and 3271 respectively.

Completed ¡§Analysis of Occupational Bladder Cancer, Leukemia, Lymphoma and Skin Cancer in Taiwan (II)¡¨. Studied the relationship between cancer and occupational factors. Cancer cases on hospitalized data of labor insurance, cancer registration, and death databank for the past 10 years were collected. Case-control study was used to calculate relative risk of bladder cancer, leukemia, skin cancer and lymphoma in various occupation or exposure so as to detect high-risk groups and further conduct occupational epidemiological studies. Industries with visible increase in cancer diseases are as follows: (1)Malignant skin cancer: aviation equipment and spare parts manufacturer, assembler and repair industry and synthetic resin manufacturer; (2)Bladder cancer: sugar manufacturer, cotton and textile industry, wood furniture manufacturer, other electronic parts manufacturer, motorcycle parts manufacturer, aviation parts manufacturer; (3)leukemia: tobacco manufacturer, chemical products manufacturer, industries using benzene; (4)Lymphatic cancer: mining and quarrying industry, water, power and fuel industry.

2. **Surveys of Occupational Diseases and Occupational Epidemiology**

Scope of research includes chemical substances, pneumoconiosis, physical hazards, musculoskeletal diseases or neck and shoulder symptoms, and occupational cancer.

Completed ¡§The VCM Cohort Study in Taiwan (III)¡¨. Research was conducted by using personal data obtained from labor insurance or census information to obtain information of subjects and conduct questionnaire surveys. It also investigated death causes of Taiwan¡¦s workers by referring to death registration files, cancer registration files. Information on history of occupational exposure, history on family diseases, self-perceived diseases, status of current exposure was also collected. Research to establish a comprehensive data of VCM worker and a follow-up network. It also conducted a standard mortality rate (SMR) of workers working in VCM operations and studied its dose-response relationship. Standard mortality ratio of the digestive system cancer and liver cancer is relatively higher. Of 127 deaths, 34 workers died of the digestive system cancers, and 20 workers died of liver cancer. The workers who exposed to VCM before 1970 had higher SMR for digestive system cancers and liver cancers.

Completed ¡§The Study of Long Term Health Effects among Sulfuric-Acid-Exposed Workers¡¨. Completed an evaluation on occupational exposure in sulfuric acid operations. Conducted a study on health effect caused by dosage of sulfuric acid and mist diameter of sulfuric acid. Completed a cross-sectional epidemiology survey on sulfuric-acid-exposed workers. Based on work site, high exposures are chemical composition and acid removal area in large factories, and in some sections in medium scale factories (acid addition and warehouse areas). Exposures in other work sites are lower than 0.2 mg/m^3.

Completed ¡§An Epidemiological Survey of Workers Exposed to Isocyanates¡¨. Conducted questionnaire survey on workers who may be exposed to isocyanates and status of occupational exposure of workers in TDI factories, number of people exposure, site interview on engineering and personal protection measures. Results revealed that at least 3.4% of workers exposed to TDI may have afflicted with asthma. Workers exposed to TDI have a high rate of being afflicted with respiratory diseases when compared to workers not exposed to TDI (21.9% and 15.9% respectively). Lung functions of exposed workers are visibly lower when compared to unexposed workers.

Completed ¡§An Investigation of the Risk Factors Related to Adverse Effects among Foam Resin Workers¡¨. Conducted a questionnaire survey on workers engaged in foam resin operations; conducted tests on liver, kidney and blood. Compiled and analyzed the correlation on concentration of foreign anti-bodies in lung and kidney functions, blood and plasma of workers in foam resin operations and types of operations. Selected workers whose lung functions have been affected by work and evaluate their allergic reaction, provided more studies on sensitive workers and proposed recommendations to protect the health of workers in foam resin operations.

Completed ¡§Analysis of Risk Factors for Occupational Cancers ¡V Urinary and Bladder Cancer¡¨ Death certification files, cancer registration files and hospitalization data from labor insurance were collected. Completed data file on dyestuff workers in the Taiwan Area and compute the standard incidence rate (SIR) for various cancer diseases. At the same time, study the relationship between the level of occupational exposure and the causes of death and causes for hospitalization.

Completed ¡§A Longitudinal Study of Respiratory Diseases among Coal Miners in Taiwan¡¨. Conducted health examination and questionnaire survey on health hazards, and analysis on health examination data to establish the dose-response relationship on coal miners. Results revealed that in terms of self-perceived illnesses, coal miners¡¦ complaints on respiratory disease is highest (22.4%), followed by heart vessel diseases (16.4%) and musculoskeletal diseases (15.8%). From health examination data, high cholesterol, high blood pressure had high prevalent rate, and abnormal rate of lung functions was 56%. Of them, the prevalent rate of restricted ventilation is highest. Those that adopt dry/wet stone processing had higher risk for obstructed lung diseases.

Completed ¡§A Longitudinal Cohort Study and Health Examination Data Analysis on Occupational Pneumoconiosis and Health Inspection Analysis¡¨. Conducted physical health examination and questionnaire survey on 299 miners with pneumoconiosis. Completed analysis on medical history, work history and physiological examination. A video recording was made on actual work procedures in mining operations. Interviewed workers who have worked for an average of 36.7 years. It took about 38 years from first exposure to being been diagnosed as being afflicted with pneumoconiosis. After leaving the mine sites, most workers have never engaged in any kind of work. Self-perceived work hazards are primarily falling stones and collapse, followed by gas poisoning and explosions. Related complications of miners afflicted with pneumoconiosis are asthma and bronchitis. Physical injuries caused by work: hearing loss and body injuries. Self-perceived illnesses: coughing, difficulty in breathing and chest pains.

Completed ¡§Survey and Analysis of Cumulative Musculoskeletal Disorder among the Transportation Employees¡¨. Conducted questionnaire of cumulative musculoskeletal disorder on 316 transportation industries, analysis of 111 workers¡¦ data with musculoskeletal diseases in special outpatient, and characteristics of high risk groups and relevant risk factors. Methods for identifying cumulative musculoskeletal disorder on transportation industries were also proposed. Health education and health protection related to occupational injuries to transportation industries were also proposed.

Completed ¡§Analysis of Hazards in Fishing Industry in Taiwan (II)¡¨. Data on labor insurance compensation from fiscal year 1994 onwards were analyzed, data on application for sea rescue funds from fishermen and fishing vessels were compiled and 300 questionnaires on self-perceived dangerous operation of various regional fisherman were conducted. It has been discovered that nearly 50% of workers interviewed complained of aching waist and back. Primary occupational hazard factors include external injuries, mechanical failure of fishing vessels, ulcers, attacks from sea animals, unable to adapt to environment. A safety manual for fishing operations have also been compiled and provided to members of various regional-fishing associations. Research results obtained can serve as an application basis for hazard prevention and strategies for fishing industry.

Completed ¡§A Study of Shoulder and Neck Pain Data among Workers in Semiconductor Industry¡¨. Conducted an analysis on questionnaire surveys and hazard factors causing neck and shoulder pains among workers in semi-conductor factories. Local medical professionals were reached to prevent or cure musculoskeletal diseases such as neck and shoulder pains.

Completed ¡§Assessment of Hearing Loss among Workers in Industries with High Noise Level ¡V Automobile Manufacturing¡¨ An evaluation on status of hearing loss among workers in the automobile manufacturing industry was conducted. Recommendations to improve hearing protection of workers in automobile manufacturing industries were also proposed.

Completed ¡§The Analysis of Substance Abuse among Taiwan¡¦s Workers¡¨. An analysis on the status of psychological stimulants and substances used by workers has been conducted. A study on influencing factors and its effects were also studied. Smoking rate among drivers of public transportation vehicles was 38.6%, while alcohol-drinking rate was 50.2%. The rates of workers in the transportation industry who has a habit of chewing betel nuts was 30.8% high. Drivers of public transportation vehicles who drank stimulating beverages are relatively low, only one of the drivers of public transportation vehicles used FM2. No one was tested positive on amphetamine on urine. Also 2 alcoholics admitted that they use amphetamine or rugby glues. Only 1 person use heroin and FM2.

Completed ¡§Epidemiological Study on the Sudden Death Among Workers (II)¡¨. Collected data on sudden death syndrome among foreign workers for fiscal year 1998 and compared it with relevant data and conduct pathological test. Completed surveys on factories or job sites where sudden death of foreign workers occur and completed all heavy metal and toxic substance tests on all cases.

3. Research on Labor Health Promotion

To actively create a healthy, safe and comfortable work environment, and to protect the physical and mental health of workers, various researches on labor health promotion has been conducted. Completed research include studies on promotion of physical fitness of workers in manufacturing plants, evaluation of fatigue and physiological conditions of workers, rehabilitation models for occupational disability, study on health management and practice, survey on dietary pattern and nutrition status, and establishment of basic energy expenditure test of Taiwan¡¦s workers.

Completed ¡§Health-Related Fitness and Health Promotion Strategy among Aging Workers in Taiwan: Manufacturing Industry¡¨. Established Taiwan¡¦s databank on health of aging workers. ¡§Evaluation of Health-Related Fitness of Workers¡¨ includes body composition, muscular strength and endurance, joint range of motion, flexibility, balance and reaction, and cardiopulmonary function. Among manufacturing industries, alcohol brewery factories, paper manufacturing plants, battery manufacturers, mining and plastic products manufacturers, electronic equipment manufacturers, textile factories and publishing and printing business have been used as subjects of research. Results of various health-related fitness tests have been compiled and analyzed. A labor health-related fitness ¡§5 Ranking Table¡¨, based on age groups and sex (below 30 years old and above 60 years old, divided into 5 age groups), was provided to serve as a reference value for follow-up studies on ¡§Evaluation of Health-Related Fitness of Workers¡¨

Completed ¡§Evaluation on Work Fatigue and Physiological Effects among High Elevation Operators¡¨. Established a database on work fatigue and physiological effects of high elevation operators in Taiwan. Completed a survey on

working environment in high elevation operations, analyzed physiological conditions of workers in high elevation operations, such as self-perceived fatigue, heart rate, blood pressure, reactions, leg circle, balancing functions, etc.; studied important factors influencing fatigue in elevated platform operations. Such as the effect on worker¡¦s fatigue caused by height of operations, rests, protective measures and effects; establish survey model for fatigue of workers in elevated platform operations. Results revealed that duration of rest is lower than the regulated rest time for high elevation workers but that does not show an over fatigue phenomenon. In terms of fatigue physiological tests, both groups showed a significant difference ($P<0.05$) in terms of balancing functions, leg circle and reaction. Research results could be used as a reference for amendment of relevant laws. An understanding of work status of high elevation operators in Taiwan at this stage could serve as a reference for management.

Completed ¡§A Model for the Establishment of Rehabilitation Network¡¨. From data collected on 228 injured workers, study the feasibility of the establishment of a rehabilitation network among current medical, society, labor administration system and possible difficulties it might encountered. 62% of the subjects are between the age of 25 to 44, and most are breadwinners of the family. The desire to go back to work among male is highest at 31%, followed by desire to participate in vocational training at 21%, and receiving social care at 15.8%. Among females, desire for social care is highest at 22%, followed by vocational training at 20% and return to work at 18%. Source of transfer media is highest from physicians in hospitals at 31%, followed by disabled and social groups at 28% and social administrative unit at 22.7%. The difficulties of disabled workers to seek employment are related to restrictions imposed by external environment (such as inadequate facilities for disabled, lack of transportation equipment for use of disabled workers, poor auxiliary equipment). With respect to research results obtained, the following recommendations have been proposed: 1. After rehabilitation, emphasis of disabled workers are to return to work, participated in vocational training programs and social welfare; 2. It is recommended that resources provided by each level of the government and organization is integrated; 3. Strengthen contact among physicians, disabled workers and social welfare groups.

Completed ¡§Health Management Practices in the Workplace ¡V Survey on Medical Health Management in Industrial Zones and Large Factories¡¨ Analysis was conducted on the following: (1)Conduct a survey on the distribution of currently licensed occupational safety and health professionals in Taiwan. (2)Conduct a survey on the current status of licensed occupational safety and health professionals when implementing business and level of job satisfaction. (3)Study awareness of occupational safety and health professionals in their professional role and functions and correlation between practice and professional development. (4)Analyze factors affecting the practice, implementation and effectiveness of occupational safety and health. (5)Design management personnel demands and directions for professional development of occupational safety and health in Taiwan. A total of 521 telephone surveys, 143 questionnaire surveys on large factories, 6 questionnaire surveys on industrial zones, 10 site interviews on factories were conducted. Recommendations for policies, practice and academic areas were proposed to serve as a reference to related organizations.

Completed ¡§Survey of Dietary Pattern and Nutrition Status in Factories in Taiwan¡¨. Through questionnaire survey

and site interviews, conducted an analysis on 5 factories, nutritional content of 6 different diets and evaluation on dietary supply to 5 factories. From health examination data of workers, analyze and study status of nutrition of workers. Concrete results could be used as a reference to improve the health of workers.

Completed ¡§Preliminary Study on the Energy Expenditure for Workers¡¨. Collected data on energy expenditure for workers in foreign countries. Established 21 energy expenditure values and divided it into 21 items. Based on size of energy, posture, divide into 9 major items. Established an initial energy expenditure value based on three types of energy expenditure of workers in Taiwan: light, medium, heavy. Numerical values obtained can be used as a reference for establishment of energy expenditure of similar work procedures.

4. **Research on Occupational Bio-medicine**

Conduct an epidemiological study on risk hazards and study on biological indicators through use of biomedicine technologies for early detection and immediately prevent occupational diseases.

Completed ¡§Study of the Biological Health Effect Index of Chromium among Electroplating Factory Workers¡¨. Conducted field surveys, health questionnaire surveys, tests on operating environment and studied relevant documents on 6 electroplating plants. Completed tests on blood, urine, hair, nail specimen of workers on 6 electroplating plants for occupational exposure to heavy metal, chromium and studied its correlation with questionnaire and health inspection data. Research results on biological exposure marker could serve as a reference for the formulation of laws to protect the health of workers.

Related Activities

I. Academic Activities

Academic activities are primarily focused on presentations of research results, and local and foreign academic exchanges. For 1998, IOSH sponsored or jointly sponsored 11 academic conferences; presented 14 journal papers in local publications, 4 journal papers in foreign publications, 24 papers in local academic conferences, and 3 papers in foreign academic conferences. In addition, four of IOSH¡¦s research projects have garnered Outstanding Research Awards for fiscal year 1997 from the National Science Council.

1. **Academic Conferences** (Table 3)

Name of the Conference	Summary of Activities	Date
Presentation of Research Results on Occupational Medicine and Occupational Health Promotion	250 people participated, presented 8 theses from the Division of Occupational Medicine.	98/1/21-22(Taipei) 98/2/12-13(Kaoh-siung)

Conference and Workshop on Occupational Stress	Objective lies in the promotion of research results on occupational stress as well as provide education on prevention of occupational stress, 130 participants attended the conference which include safety and health professionals from industries, professionals in occupational hygiene and medicine, human resources management personnel. During the conference, experts and scholars provided research results and actual experiences and training.	98/3/31 98/4/12 (Kaoh-siung) 98/4/15-16(Taipei)
Conference on Construction Safety for Fiscal Year 1997	300 participants which included labor inspectors, safety and health professionals from industries, researchers in related fields, topic speech, 7 papers included.	98/1/19 98/2/6 98/2/16
1998 Conference on Application of Research Results on Industrial Ventilation	75 participants attended the conference, including technicians on industrial safety and health, labor inspectors, safety and health professionals from industries. Presented 7 thesis relating to study and technologies on design concepts of industrial ventilation, air mask, conduit pipe design and relevant concepts and practice in computer aided programs. Conduct joint discussions of problems among participants, and exchange experiences.	98/2/19-98/2/20
Negotiate conference on ¡§Methods to Be Adopted to Reduce Occupational Hazard¡¨	IOSH, together with the Center for Industrial Safety and Health Technology, gathered experts for a small group discussion, concrete conclusion provided to IOSH for reference, 3 sessions were held, focusing on ¡§Occupational Safety and Health Management¡¨, ¡§Prevention of Fire Explosions¡¨ and ¡§Construction Safety¡¨. Participants included IOSH¡¦s Consultative	98/3/4 98/3/6 98/3/11

	Committee on Occupational Safety and Health, business representatives, labor representatives, as well as scholars and experts on relevant topics.	
1998 Academic Conference on Industrial Hygiene	This conference is held in cooperation with Chinese Medicine College, 500 participants attended which included researchers in related fields, labor inspectors, safety and health professionals from industries. Presented 125 papers.	98/3/21- 98/3/22
1998 Practicum on Guidelines for Occupational Hearing Protection Plan	70 participants attended the practicum which include industrial safety and health technicians, labor inspectors, safety and health professionals from industries. The objective of this practicum lies in strengthening promotion of concept of occupational hearing protection plan in industries. It is hoped that safety and health technicians, experts and scholars, and the academic community could further promote relevant knowledge on guidelines for hearing protection plan to expand use of industries as a reference.	98/3/26-98/3/27
Conference on Mechanical Safety for Fiscal Year 1997	Approximately 200 participants attended the presentation, among which included labor inspectors, safety and health professionals from industries, and researchers in related fields. Topic speech, 6 papers presented.	98/4/22 98/4/28 98/4/30
Conference on Ergonomic Evaluation and Control in Work Places	70 participants attended the conference, which include industrial safety and health technicians, labor inspectors, safety and health professionals from industries. Presented 10 theses on application of ergonomic in work place, evaluation of ergonomic engineering and general	98/4/23-98/4/24

	concepts and practice on how to prevent ergonomic hazards. Participants have a joint discussion of the problem and exchange experiences and views.	
Conference on Petrochemical Safety for Fiscal Year 1997	Approximately 200 people attended the presentation, which included inspectors, safety and health professionals from industries, and researchers in relevant fields. Topic speech, 5 papers presented.	98/6/03 98/6/05
1998 International Conference on Aerosol Technology, Environmental Monitoring and Control	Approximately 200 people attended the meeting. In addition to inviting foreign experts to provide speeches, 46 papers on relevant research have been presented. These include (1) aerosol hazard, (2) aerosol control, (3) technology for aerosol sampling, promote application and research of aerosol technologies in industrial health.	98/10/2-98/10/3
Seminar on Use of Hand Tools and Ergonomic Engineering	Gathered experts and scholars to introduce ergonomics and issues relating to skills in using hand tools. 70 industrial safety and health technicians, labor inspectors, safety and health professionals from industries participated the seminar. Promote ergonomic engineering concepts, provide a reference to industry.	98/11/25
1998 Taipei International Academic Conference on Environmental Factors and Mutagenesis	This conference is held in cooperation with the R.O.C. Environmental Occupational Medicine Association, invited local scholars and experts and 9 foreign experts from 13 countries, 33 papers included.	98/11/25- 98/11/27

Seminar on Hazard Prevention in Hot Environment	70 industrial safety and health technicians, labor inspectors, safety and health professionals from industries participated the seminar. The objective lies in promoting concepts of hazard prevention in hot environment, promote results of evaluation models and computer simulation software in hot environment to serve as a guidelines for industries.	98/12/30

1. **Presentation of Theses ¡V Local Publications (Table 4**)

Title	Publication	Authors
Recent Development in Mechanical Safety	Institute of Occupational Safety and Health Journal, Vol. 6, No. 1	Wu Shih Hsiung*, Kao Chung Yang*
Detailed Design and Technical Analysis of an Overturn Warning Device for Forklift Trucks	Institute of Occupational Safety and Health Journal, Vol. 6, No. 3	Chiu Chun Cheng, Kao Chung Yang*
Development of Virtual Reality Simulation Training System for Cranes	Labor Review Magazine, No. 122	Kao Chung Yang*
Study of Implementation of BS 8800 In Industry	Industrial Safety and Health, No. 104	Tai Chi Fu*, Chang Cheng Ming*
Development of an Alarm System for Preventing Mobil Cranes from Accidental Contact with Overhead Power Lines	Institute of Occupational Safety and Health Journal, Vol. 6, No. 2	Tau Chi Fu*, Su Wen Yuan *, Yang Cheng Fa, Wu Chi Ruei, Yen Shih Hsiung,Lai Ching Neng, Ku Chia Hao, Yen Chi Yao
The Application of Multi-cell Well-mixed Model in Overall Heat Exchange	Institute of Occupational Safety and Health Journal, Vol. 6, No. 1	Chen Yiu Kang*, chung Chi Chiang, Yeh Wen Yu*, Chen Chun Wan*
A Study on Chromium Mist Control	Institute of Occupational Safety and Health Journal, Vol. 6, No. 1	Chen Wan Chun*, Lin Chien Heng, Lin Yu Chang, Yeh Wen Yu*, Cheng Yu Kang*

A Study on the Arrangement of Air Conditioning Inlet/Outlet and the Thermal Comfort	Institute of Occupational Safety and Health Journal, Vol. 6, No.	Chung Chi Chiang, Chen Yu Kang*, Yeh Wen Yu*, Lin Shou Hsiang*
Study on Legionella Penumophila in a Medical Center	Institute of Occupational Safety and Health Journal, Vol. 6, No. 4	Chang Ching Wen*, Chu Meng Lin, Lim Khin Shi, Lee Chia Ming
A Study on HLA Typing and Work-Related Sensitization to Isocyanates	Institute of Occupational Safety and Health Journal, Vol. 6, No. 3	Lee Fan, Chiung Yin Mei*, Leu Yu Tien, Chou Chi Fu, Chen Gya Jung
An Investigation of Immune Functions and Influence of Factors on Hogfarm Workers	Institute of Occupational Safety and Health Journal, Vol. 6, No. 1	Chiung Yin Mei*, Huang Ju Wei*, Yang Tsan,, Wei Su Jen
Subjective Fatigue in Visual Display Terminal Workers	Institute of Occupational Safety and Health Journal, Vol. 6, No. 2	Mao I Fang, Huang Ju Wei*, Chen Chiu Jung*, Tsay Ming Hwang, Cheng Shu Fang*, Chow Chin Kuan, Chen Mei Lien
The Effect of Heart Rate of Performing Workload In Hot Environment	Institute of Occupational Safety and Health Journal, Vol. 6, No. 2	Chen Mei Lien, Huang Ju Wei*, Chen Chiu Jung*, Cheng Shu Fang*, Mao I Fang

Note: *IOSH Staff

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Presentation of Theses ¡V Foreign Publications(Table 5)

Title	Publications	Authors
A Three-Dimensional Mathematical Model for Predicting Spinal Joint Force Distribution during Manual Lifting	**Clinical Biomechanics Vol. 13 Supplement No.1,1998**	Cheng, C. K., Chen, H. H., Kuo H. H., Lee, C. L.*, Chen, W. J.,

		Liu, C. L.
A Computer Simulation Study on Bioaerosol colony Counting Error due to Masking Effect	Annals Occup. Hyg. Vol.42 No.7 pp501-510	Chen, C. C., Yu, T. S., Chang, C. W.*, Shih, T. S.*, Hwang, J. S.
Immunoblot Analysis of Components of Barley recognized by IgE Antibodies in Sera from Pigfarm Workers. .	Electrophoresis, Vol. 19	Hsiung Ing Mei*,Shen Hong The, Huang Ju Wei*
Evaluation of Sensitization by Biological Allergens for Respiratory Disorders in Swine Farm Workers.	Advanced in the Prevention of Occupational Respiratory Disease. Excerpta Medica Internationa Congress Series 1153, 1998.	Hsiung Ing Mei*, Huang Ju Wei*, Du Chung Li *, Chang Ching Wen*, , Shen Hong Teh, Wei Su Jen*, Chuang Yu Chi, Chou Chi Fu
Increased Morbidity Odds Ratio of Primary Liver Cancer and Cirrhosis of the Liver Among Vinyl Chloride Monomer Workers	Occupational and Environmental Medicine, 1998, Vol. 55	Du Chung Li*, Wang Jung Der

Note: *IOSH Staff

4. **Presentation of Theses ¡V Local Academic Conferences (Table 6)**

Topic	Conference	Date	Presenters
Evaluation Study on Implementation of BS 8800in Industries	**5th Cross Strait Academic Conference on Occupational Safety and Health**	98/11/24	Tai Chi Fu*, Chang Cheng Ming*
Study on Hearing Test Standard and Hearing Loss Threshold Values	Presentation of Research Results on Occupational Medicine and Labor Health Promotion	98/1/21-2/13	Chang Su Ru*, Pan Chi Hong*

Study on Suitability of Ergonomic Checklist in Work Site	1998 Symposium on Industrial Hygiene	98/3/21-98/3/22	Yeh Wen Yu*, Lin Yen Huei*, Chen Chi Yong*
Survey on Dust Exposure in Masonry	1998 Academic Conference on Industrial Hygiene	98/3/21-98/3/22	Lin Ming Hsiu*, Yeh Wen Yu*
A Study of Establishing the Standard for Respirator Fit Testing ¡VVarious Face Shapes and Respiration Valve	1998 Academic Conference on Industrial Hygiene	98/3/21-98/3/22	Hsu Rong Nan, Chien Hong Min, Chen Chun Wan*
Survey on Fatigue Status of Operators of Video Display Terminal	1998 Academic Conference on Industrial Hygiene	98/3/21-98/22	Mao I Fang, Huang Ju Wei*, Chen Chiou Jong*, Tsai Ming Huang, Chen Su Fang*, Chou Ching Kuang, Chen Mei Lien
Experiment on the Effect on Chromium Mist Control Methods in Chromium Electroplating Tanks	1998 Symposium on Industrial Hygiene	98/3/21-98/3/22	Chen Chun Wan*, Lin Chien Heng, Lin Yu Chang, Yeh Wen Yu*, Chen Yu Kang*
Segment Inertial Properties of Chinese Adults Determined MRI	1998 Conference on Ergonomic Engineering	98/5/15	Chen, H. H. Chen, C. K., Lee C. L.*
The Effect of Belt on Lumbar Curvature Under Static Posture	1998 Conference on Ergonomic Engineering	98/5/15	Lee Yung Huei, Chen Chi Yong*
Study and Analysis on Occupational Exposure to Chromium in Electroplating Industries	The 6th Conference on Exchange of Analytical Technologies	98/16	Pan Chi Hong*, Chen Chiou Jong*, Chuang I Chuan, Huang Yu Li, Lin Teh Hsien
The Potential Flow Field Generated by the Flanged Hood Openings of Various Shapes	1998 Aerosol Conference	98/10/2 - 98/10/3	Chen Yu Kang*, Chen Chun Wan*, Yeh Wen Yu*, Chung Chi Chiang
A Simulation of Flow Field and Particle Trajectories Around Exterior Hoods	1998 Aerosol Conference pp355-362	98/10/2 - 98/10/3	Chen Yu Kang*, Yeh Wen Yu*, Chen Chun Wan*

Survey on Dust Exposure in Masonry	1998 Aerosol Conference pp406-416	98/10/2 - 98/10/3	Lin Ming Hsiu*, Yeh Wen Yu*
A Local Exhaust Device Duct Design Program ¡V Data Structure and Computation Validation	1998 Aerosol Conference	98/10/2 - 98/10/3	Chen Yu Kang*, Huang Chien Chang, Lin Ching Feng, Lu Chung Hsien, Yeh Wen Yu*, Chen Chung Wan*
The Study on Effects of Face Shapes of Wearer on Air Tight Coefficient of Half-Mask Respiratory Protection Equipment	1998 Aerosol Conference pp562-572	98/10/2 - 98/10/3	Chen Yu Kang*, Chung Chi Chiang, Yeh Wen Yu*, Chen Chun Wan*
The Multi-Cell Well-Mixed Model and Its Application to the Optimization Design of the General Ventilation	1998 Aerosol Conference	98/10/2 - 98/10/3	Chen Yu Kang*, Chung Chi Chiang, Yeh Wen Yu*, Chen Chung Wan*
Study on Safety Use to Prevent Electrocution from Welding Machine	1998 National Seminar on Occupational Safety and Health	98/11/3	Su Wen Yuan*
Study on Applicability of Checklist for Musculoskeletal Injuries in Work Environment	1998 National Seminar on Occupational Safety and Health	98/11/2-98/11/4	Yeh Wen Yu*, Lin Yen Huei*
Status of Effect of Size of Respiratory Protection Equipment on Air Tight Coefficient	1998 National Seminar on Occupational Safety and Health	98/11/2-98/11/4	Chen Chun Wan*, Yeh Wen Yu*
Effects of Ligaments and Small Area Knee Joint on Waist Pressure	1998 Joint Academic Conference of ROC Osteopathy Research Association / Biomechanical Association	98/11/21	Lin Yen Huei,Chen Cheng Kung,,Chen Yung Heng, Chen Wen Tse, Lee Cheng Lung*
Electric Circuit Modeling of Dust System in the Local Exhaust Devices	15th Academic Conference of China Mechanical Engineering Association	98/11/27-98/11/28	Chen Yu Kang*, Yeh Wen Yu*, Chen Chung Wan*, Chung Chi Chiang

The Potential Flow Field Generated by the Flanged Hood Openings of Various Shapes	15th Academic Conference of China Mechanical Engineering Association	98/11/27-98/11/28	Chen Yu Kang*, Yeh Wen Yu*, Chen Chung Wan*, Chung Chi Chiang
The Establishment of a Subjective Noise Protection Equipment with Sound Reducing Test System	The 11th Academic Conference of ROC Sound Association	98/12/11	Lu Tsuo Hsin, Pan Chi Hong*, Sun Teh Hsuan, Chen Chiou Jong*, Sun Hong Chuan, Chang Su Ru*
The Study on Importance of Acoustic Measurement in Hearing Protection Plan for Noisy Operating Environment	The 11th Academic Conference of ROC Sound Association	98/12/11	Yeh Wen Yu*, Lin So Hsiang*
Thesis Collection on Evaluation of Background Sound Volume in Hearing Inspection Room	The 11th Academic Conference of ROC Sound Association	98/12/11	Chang Su Ru*, Chen Chiou Jong*, Chen Liang Hsing, Chen Hsing, Pan Chi Hong*

4. Note: *IOSH Staff

5.

Presentation of Theses ¡V Foreign Academic Conferences (Table 7)

Topic	Conference	Place	Date	Authors
Musculoskeletal Complaints in the Taiwanese Working Population	ISEE/ISEA Joint Conference 1998	USA	87/8/15-87/8/19	Y. L. Guo, K. S. Lin, W. Y. Yeh*, C. W. Chen*
Load Constant on Manual Handling for Chinese Subjects	The 5th Pan-Pacific Conference on Occupational Ergonomics	Japan	87/7/21	Chen, C.Y.

Determinants of Morbidity Cost Among Permanently Disabling Victims Resulting From Occupational Injuries in Taiwan.	3rd International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders	Finland	87/9/21-87/9/25	J. J. Ho*, Wang, J.D.
A Study on Immunodysregulation of Welding Workers Exposed to Heavy Metals.	The 10th International Congress of immunology.	India	1998	Hsiung Ing Mei*, Wu Chin Ching, Huang Ju Wei*, Wei Su Jen, Lai Chun Hsiung, Chen Chiou Jong*

Note:*IOSH Staff

4.

Awards (Table 8)

Award	Recipient	Reason for the Award	Date
1998 Academic Conference on Industrial Hygiene ¡V Outstanding Thesis	Hsu Rong Nan, Chien Hong Min, Chen Chung Wan*	A Study of Establishing the Standard for Respirator Fit Testing ¡VVarious Face Shapes and Respiration Valve	98/3/21
National Science Council Outstanding Research Award ¡V Class A	Chen Chi Yong*	Study on Localization of Guidelines for Manual Lifting	98/4
The 1998 IOSH Initiated Research ¡V 2nd Place	Chen Chun Wan*, Chen Yu Kang*, Yeh Wen Yu*	Air Tight Test of Respiratory Protection Equipment Tested on Human Being	98/7/16
The 1998 Aerosol Conference Outstanding Technical Thesis Award	Chen Yu Kang*, Yeh Wen Yu*, Chen Chun Wan*	The Potential Flow Field Generated by the Flanged Hood Openings of Various Shapes	98/10/2

Note: *IOSH Staff

I. Publications

I. Primary publications of IOSH include research reports, the Institute of Occupational Safety and Health Journal, IOSH Newsletter, Annual Report, and technical books (see Table 9). Depending on the nature of the

organization, appropriate publications are sent to enterprises, government agencies, research agencies and associations, in order to disseminate research results and information on occupational safety and health. For fiscal year 1998, a total of 10 new publications were published, with approximately 5,000 copies printed.

Table 9 Publications for Fiscal Year 1998

Title	Type	Issues	Copies	Remarks
1997 Annual Report	Yearly	78	150	To save on printing expenditure and achieve promotion purposes, starting fiscal year 1997, annual report will be available on the internet, A compact disk version will be sent to various libraries for filing and management.
Institute of Occupational Safety and Health Journal	Quarterly	4	1100	Vol. 6 No. 1 - No 4
IOSH Newsletter	Bi-monthly	6	4600	No. 27-32
Technical Books	Irregular	6	200	Titles as per Appendix

II.

Information Services

1. **Library**

1. In conjunction with the development of the National Information Infrastructure, IOSH continues to expand its library collection and to upgrade the quality of its software and hardware, in order to support safety and health research. For fiscal year 1998, the library has a collection of 3,290 books and 100 periodicals (see Table 10), including research reports, bulletins, conference proceedings, reports of fact-finding missions and studies. It is also open to the public, providing up-to-date safety and health information services to enterprises.

Table 10 Collection in IOSH Library

Type	1997	Addition / Subtraction in 1998	Total in 1998
Books	3160	+130	3290
Subscribed Periodicals	99	+1	100
Chinese	37	+3	40

English	47	-2	45
Japanese	15	0	15
Audio Visual Materials	257	0	257
Video Tapes	43	0	43
Cassettes	214	0	214

2.

IOSH¡¦s Computer/Networking Services

The main purpose of the IOSH¡¦s computer/networking services is to support various occupational safety and health researches, and provides useful information on occupational safety and health. In 1998, the Internet networking services were much expanded. We provide some occupational safety and health information, which includes the Institute of Occupational Safety and Health Journal, newsletters and papers of IOSH, and other IOSH¡¦s publications. All data can be read or downloaded through our world-wide web (WWW) service.

I. Technology Promotion and Services

I. For fiscal year 1998, IOSH sponsored 1 exhibitions, assisted in 9 investigations into suspected cases of occupational diseases, and offered inspection apparatus calibration services 4 times (see Table 11 - 13).

Table 11 Exhibitions

Topic	Summary of Activities	Location	Date
Exhibition on Occupational Safety and Health Equipment, Exhibition on Personal Protection Equipment and Exhibition of Research Results of IOSH	Coordinate with1999 National Seminar on Occupational Safety and Health, exhibited 16 research results of IOSH, attracted more than 3,000 people to attend.	Commercial Times Plaza	98/11/02 - 98/11/04

Table 12 Investigation into Suspected cases of Occupational Diseases

Name of the Organization	Items Investigated	Date
Steel Surface Processing Industries	Nasopharangeal Cancer of Nickel Electroplating Liquid	98/3/6

Labor Safety and Health Department of CLA	Provide data to the Department of Occupational Safety and Health to print 10,000 copies of booklet on ¡§Prevention of Occupational Needlestick Injury¡¨, promoted to Bureau of Health, hospitals and relevant associations.	98/4-87/6
Labor Safety and Health Department of CLA	Provide data to the Department of Occupational Safety and Health to print additional copies of ¡§Guidelines for Hearing Protection Plan¡¨, co-sponsored 15 seminars on hearing protection plan.	98/4-87/6
Initiative Survey	Ergonomic Evaluation on Taipei Municipality Drivers Driver Knee Arthritis	98/4/20
Center for Industrial Safety and Health Technologies of Industrial Technology Research Institute	Assist in handling seminars on improvement technologies for duct local exhaust pipe design program. 80 people participated, knowledge could be applied to improve work environment.	98/4/29-4/30
Provincial Department of Health	Provide basic health professionals of provincial department of health with educational materials and qualified teachers to promote hearing protection plan.	98/5/12
Semi-conductor Technology Plants	Skin Diseases.	98/6/3-98/7/23
Labor Inspection Department of CLA	According to CLA¡¦s official document No. 034478, provide relevant data on tuberculosis and respiratory protection equipment to IOSH, the Department of Labor Inspection quoted this as reference data for ¡§Inspection of Medical Health Protection Service Industries¡¨ and promote concepts on respiratory protection equipment.	98/8/7
Manual Transport Paved Tracks	Complications on waist nerves.	98/10/8

Table 13 Inspection Calibration Services Provided to Inspectorates

Name of the Agency	Services	Date
Inspection Organizations	71 photometers	98/2-98/4
Inspection Organizations	126 noise meters	98/2-98/5

Inspection Organizations	1 wind tunnel, 30 anemometers	98/2-98/5
Inspection Organizations	22 oxygen and combustible gas detectors, 44 industrial safety inspection apparatus	98/3-98/5

Significant research results of the IOSH, such as highly mobile ergonomic chair, new safety helmet for construction sites, have a set of regulations and procedures to follow. Patent application and technology transfer have been conducted. It is hoped that this business activity promotion could urge the further integration of research and practice and actively contribute to local safety and health work (see Table 14).

Table 14 Patents

Patent No.	Invention	Inventors
United State Patent Number: 5,774,900	Industrial Safety Helmet	Shih-Hsiung Wu*, Chung-Yun Gau*, Yeh-Liand Hsu, Huoy-Shyi Tsay
R.O.C. Patent No. 86220191	Wheel Type Retaining Wall Protection Device	Wu Shih Hsiung*, Lin Jen Chung, Hsu Cheng Yang
R.O.C. Patent No. 86220192	Movable Type Retaining Wall Protection Device	Wu Shih Hsiung*, Lin Jen Chung*, Hsu Cheng Yang
R.O. C. Patent No. 86210834	Warning Device to Mobile Cranes to Prevent Accidental Contact with Overhead Power Lines	Tai Chi Fu*, Su Wen Yuan*, Yang Cheng Fa, Wu Chi Ruei, Yen Shih Hsiung
Under Review by the European Union Patent No.96116678.2	Method and Device for Size Selective Sampling for Airborne Particulates	Chen Chih Chieh, Shih Tong Shen*, Yeh Wen Yu*, Lai Chuan Yu
ROC and US Patent Application in Process	Device to Test Vapor Skin Absorption Dosage and Test Methods	Shih Tong Shen*,Wang Peng Yao
1996/11 US Patent No. 5575534	Highly Mobile Ergonomic Chair	Yu Chih Yuang,,Lee Cheng Lung*
ROC Patent No. 139806	Highly Mobile Ergonomic Chair	Yu Chi Yuang, Lee Cheng Lung*
ROC Patent No. 138568	Knife for Meat Processing	Wang Mao Chun, Lee Cheng Lung*, Wu Hsiu Wei

Note: *IOSH Research Staff

In terms of exhibition activities, IOSH continues to hold national occupational safety and health seminars. ¡§Exhibition on Occupational Safety and Health Equipment, Exhibition on Personal Protection Equipment and Presentation of Important Research Results¡¨ attracted more than 3000 people. Meanwhile, inasmuch as major cases of occupational hazards were mostly new employees who have not served the company for 1 full year, IOSH has started to design and manufacture ¡§Mobile Exhibition Hall of Occupational Safety and Health¡¨ in cooperation with the National Natural Science Museum in July 1998. It uses space and mobility of large fabricated and expandable containers to actively provide workers and students relevant knowledge on prevention of occupational hazards. Exhibition methods include application of virtual reality scenario, computer animation, World Wide Web, eyesight differences, posters and other exhibits. As a result, content of each exhibition has been innovative and interesting, thereby increasing the effects of exhibition. Over 20 topics in our exhibition will be available, which includes: introduction of significant research results of IOSH; employment information on Employment and Vocational Training Administration; ergonomic engineering; noise prevention; prevention of electrocution, fire explosions, dust particle hazard, falling hazards; safety of machinery and equipment; catastrophic events on lack of occupational safety and health, confined space, hazard symbols, factors leading to occupational injuries; personal protection equipment; introduction to occupational diseases and hazards of organic solvents. It is anticipated that in the future, 50,000 people/time workers and students can attend the exhibitions. The amount of visitors will be 50,000 per year by estimate.

II.

International Exchange and Cooperation

Table 15 Research Trip

Area	Country, Organization	Topic	Name	Date
Research Trip	USA, Canada	Visited USA and Canada to observe collapse protection technologies and safety management.	Chang, Chih Chi	98/6/9-98/6/22
Research Trip	Finland	The technologies of hazard control in workplaces	Lee, Cheng Lung	97/5/26-98/6/6
Research Trip	U.S.A.	Occupational Diseases	Du, Chung Li	98/7/12-99/1/12

Appendices

I. **Technical Book Collection**

No.	Title	Date

IOSH87-T-023	Safe Evacuation Evaluation for Hazard Emergency (Software Included)	98/7
IOSH87-T-024	The Design of Computer-Aided Fault Tree Analysis (Software Included)	98/7
IOSH87-T-025	Safety and Health Guidelines for Human-Machine Interface for Non-motorized Hand Tools (Revised Edition)	98/7
IOSH87-T-003	Technical Manual on Selection of Protection Equipment ¡V Safety Helmet (2nd Edition)	98/8
IOSH87-T-009	Technical Manual on Selection of Protection Equipment ¡V Respiratory Equipment (2nd Edition)	98/8
IOSH87-T-010	Technical Manual on Selection of Protection Equipment¡V Hearing Equipment (2nd Edition)	98/8