



**45** Extramural  
Research Projects  
**74** Intramural  
Research Projects

# CONSTRUCTION

**NIOSH RESEARCH PROJECTS**  
**August 1997**



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



## *Foreword*

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In 1989, Congress began to appropriate funds targeting construction safety and health research. At that time, construction workers experienced one of the highest occupational fatality rates and had the highest rate of injuries and illnesses resulting in lost work days. Additionally, while the construction industry employed 5 - 6% of the U.S. workforce, it accounted for more than 15% of workers' compensation costs.

With this new initiative, the National Institute for Occupational Safety and Health (NIOSH) has developed a nationwide infrastructure of research and other programs that address many issues unique to the construction industry. Currently, the Institute funds 45 extramural and 74 intramural construction-related projects, and support many more activities related to the construction industry.

Continued safety and health research will help further the significant progress made toward worker protection in the construction industry. However, the future of health and safety in the construction industry does not lie with a single organization or entity. NIOSH has found that it takes the collaboration of many parties -- including those in labor, industry, academia, private organizations and government -- to maximize the effectiveness of this investment in construction worker health and safety.

In 1996, NIOSH unveiled the National Occupational Research Agenda (NORA), which defines the Nation's occupational safety and health research priorities for the next decade. Approximately 500 organizations and individuals outside NIOSH participated in the development of the research agenda. NORA does not specifically single out an industry or industry segment, however it focuses attention on 21 research priorities. Eighteen of these 21 priority research topics relate directly to construction.

This document organizes the NIOSH construction related projects by NORA priority research topic. The distribution of projects illustrates how NORA provides an effective tool to integrate coordinated research efforts within specific sectors, such as construction, with the ultimate goal of reducing illness and injury by gathering and translating safety and health knowledge into effective preventive actions.



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## Highlights of NIOSH Construction Safety and Health Research

Protecting construction workers from injury and disease ranks among the greatest challenges in occupational safety and health.

- More than 7 million persons work in the construction industry, representing 6% of the labor force. Approximately 1.5 million of these workers are self-employed.
- Of approximately 600,000 construction companies, 90% employ fewer than 20 workers. Few have formal safety and health programs.
- From 1980-1993, an average of 1,079 construction workers were killed on the job each year, more fatal injuries than in any other industry.
- Falls caused 3,859 (25.55%) of construction worker fatalities between 1980 and 1993.
- 15% of workers' compensation costs are spent on construction injuries.
- Assuring safety and health in construction is complex, involving short-term work sites, changing hazards, and multiple operations and crews working in close proximity.

### NIOSH Research Solves Safety and Health Problems in Construction

From October 1993 through March 1996, NIOSH researchers conducted 43 health hazard evaluations for construction industries and responded to 171 construction-related calls. Since 1985, NIOSH researchers have developed recommendations for preventing fatal injuries based on more than 425 field evaluations of fatal events in the construction industries. These evaluations were conducted as part of the NIOSH Fatality Assessment and Control Evaluation (FACE) Program. The recommendations are disseminated through NIOSH Alerts, such as those described below, and monographs.

NIOSH researchers identify causes of and develop programs to prevent injuries and fatalities in construction. NIOSH also collaborates with partners from the construction industry to develop new strategies to reduce construction worker injuries and illnesses.

#### • *Controlling Lead Toxicity in Bridge Workers*

With funding from NIOSH, Connecticut state agencies and Yale University initiated the Connecticut Road Industry Surveillance Project (CRISP) to reduce lead toxicity in bridge workers. CRISP provides medical examinations and procedures to monitor and reduce occupational lead exposures at bridge sites; on-site technical assistance to overcome problems in reducing lead exposures; and a centralized, statewide surveillance system to monitor blood lead levels in workers.

CRISP saves Connecticut \$2.5 million each year in workers' compensation costs. With CRISP, blood lead levels have decreased by 50%. Efforts are underway to implement this approach in other states.

NIOSH published an Alert, *Preventing Lead Poisoning in Construction Workers* (DHHS [NIOSH] Publication No. 91-116a), to publicize the hazards associated with lead-containing paint, and to provide recommendations to reduce lead exposure and prevent lead poisoning among workers involved in demolishing or maintaining bridges and other steel structures.

#### • *Controlling Asphalt Fume Exposures During Paving*

More than 500,000 workers are exposed to asphalt fumes while paving roads, roofing, and waterproofing. Molten asphalt generates fumes that can cause skin diseases and eye and respiratory tract irritation. NIOSH laboratory studies found that fumes from asphalt roofing materials have potential cancer-causing and mutagenic properties.

Through an interagency agreement with the Department of Transportation, NIOSH is evaluating industry-developed control technology to reduce workers' exposure to asphalt fumes in road paving. NIOSH's involvement was requested by the National Asphalt Pavement Association, the industry organization of asphalt paving equipment manufacturers. Preliminary results suggest that these control systems will capture a significant amount of the asphalt fumes generated during the paving process. NIOSH has published the first of these results in a publication entitled *Engineering Control Guidelines for Hot Mix Asphalt Pavers, Part 1 New Highway-Class Pavers* (DHHS [NIOSH] Publication No. 97-105).

#### • *Preventing Electrocutions of Crane Operators and Crew Members*

Each year, electrocutions represent 7% of injury-related fatalities. NIOSH onsite investigators found that 13% of work related electrocutions involved crane contact with overhead power lines.

After evaluating the circumstances of these electrocutions, NIOSH disseminated two Alerts that describe procedures and precautions to assure safe crane operation around power lines (DHHS [NIOSH] Publication Nos. 85-111 and 95-108).

NIOSH disseminated a similar Alert describing electrocutions when erecting, moving, or working from scaffolds near power lines (DHHS [NIOSH] Publication No. 91-110).

#### • *Preventing Injuries and Deaths Caused by Falls*

Falls account for approximately 9% of traumatic occupational deaths, and fatal falls from scaffolds account for 17% of falls from elevations. Investigations by NIOSH suggest that fatal falls result from defective scaffold equipment, improper installation or operation, improper worker training, or failure to use appropriate fall protection equipment. NIOSH disseminated an Alert (DHHS [NIOSH] Publication 92-108) to encourage the proper use of scaffold equipment and fall protection systems.

# Extramural and Intramural Research Projects

## Extramural Research Projects

### Grants

#### • Research Tools and Approaches

##### I. Control Technology and Personal Protective Equipment

###### Load Monitoring for Safe Construction

**Researcher:** Dryver R. Huston, Ph.D.

**Affiliation:** University of Vermont  
Burlington, Vermont

**Keywords:** Vertical and lateral loads, concrete construction,  
real-time load, deflection monitoring

**Purpose:**

To measure the vertical and lateral loads experienced by the shoring system of a reinforced concrete building under construction.

**Abstract:**

The overall goals of this project are to develop and implement a real-time load and deflection monitoring instrument for buildings during construction, to develop an improved understanding of critical construction loading conditions, and to develop guidelines for safe construction practices specifically associated with multistory reinforced concrete construction. The fundamental hypotheses for this work are (1) that the primary cause of construction failures is inadequacy of the temporary support elements such as vertical shores and lateral bracing; (2) that an investigation of load and deflection histories during actual projects can contribute greatly to our understanding of critical loading conditions; and (3) that this information can be used as the basis for improved construction procedures and guidelines for safe design and construction. In addition to the instrumentation developed and employed, tangible outcomes in the form of design guidelines will include (at a minimum) suggested modifications to current code-specified design loads, improved methods for modeling structural loads during construction, methods for accounting for vertical and horizontal impact loads, and suggested real-time monitoring schemes for excess load and deflection during construction operations.

###### Smart, Safe Scaffolding

**Researcher:** Peter L. Fuhr, Ph.D.

**Affiliation:** VT Sensing, Inc.  
Underhill, Vermont

**Keywords:** Load monitoring, recording instrumentation,  
catastrophic failure, construction shoring systems

**Purpose:**

To design, build and test load monitoring and recording instrumentation so that catastrophic failure of construction shoring systems can be anticipated and prevented.

**Abstract:**

Over the past 25 years there have been more than 85 collapses of structures under construction that have been directly attributable to formwork failure. We propose to develop sensing systems and techniques applicable to the monitoring of construction site shoring and scaffolding. This work will be demonstrated at our in-house lab facilities as well as at "real-world" major construction sites. It is anticipated that this sensor network will provide significant information about the load distribution on shoring systems — information that is currently not available. This information will allow dangerous situations to be quickly identified so that corrective action can be taken. Thus the risk of injury or loss of life at a construction site will be reduced, possibly leading to lower liability insurance costs. Furthermore, this information may also be used to formulate new construction codes that will further enhance construction work safety.

###### Field Studies with Innovative Safe Excavation Technologies

**Researcher:** Leonard E. Bernold, Ph.D.

**Affiliation:** North Carolina State University  
Raleigh, North Carolina

**Keywords:** Safe excavation technologies, mortality, injuries,  
field studies

**Purpose:**

To study the efficacy of three innovative excavation technologies that promise to drastically reduce or even eliminate the many deaths and injuries that are common in excavation today.

**Abstract:**

Three technologies have been developed to eliminate the need for having workers in the trench: (1) the CAD-Excavator-Integrated Spatial Positioning System (CEISPS); (2) Excavator-Mounted Buried Utility Detection System (EM-BUDS); and (3) Pipe-Manipulator Attachment (PMA). All three technologies have already been prototyped and tested in a laboratory environment. The next phase of research will include studies and demonstrations in the field, where comparative evaluations can be conducted. The first segment of this project will focus on ruggedizing the working prototypes and the establishment of base data on the productivity and quality of existing methods. Several methods for excavating and pipelaying are being used today because of different conditions and skill requirements. EM-BUDS needs at least one year of work to develop a feature library and complementary soil sensing/scanning capabilities to locate buried utilities as accurately as necessary. The second segment will modify existing excavators for the quick attachment of hardware. The training of operators participating in the experiments is necessary, as well as establishment of data collection procedures, pre-testing of the systems under field conditions, and eventual modifications to increase their effectiveness. The third segment will involve conducting field studies and evaluating collected data as compared with the base data to determine the effectiveness of the new system. The final segment will be a demonstration project(s) on one or multiple sites.

## II. Exposure Assessment Methods

### An Exposure Matrix for Construction Painters

**Researcher:** Philip L. Bigelow, Ph.D.  
**Affiliation:** Colorado State University  
 Fort Collins, Colorado  
**Keywords:** Solvent exposures, construction painters, task-exposure matrix, video exposure techniques, exposure assessment

**Purpose:**  
 To develop a task-exposure matrix for solvent exposures in construction painters.

**Abstract:**  
 Construction painters are exposed to a wide variety of substances that may cause acute and chronic adverse health effects. This project will provide quantitative information on exposures in construction painting. It will focus on specific work tasks, and a new methodology will be developed in which exposures can be accurately estimated on the basis of self reports of work activity. This exposure assessment technique will be valuable when dealing with workers who perform tasks at different job sites or who perform a variety of activities. The new technique will enhance the capabilities of health scientists in the assessment of exposure. Three hundred workers at job sites in Colorado will participate in the study. Video exposure monitoring will be used to link specific work tasks to exposure levels. A database of tasks and exposure levels will be developed for later use in the characterization of exposure on the basis of information from self reported activities. Information obtained at the job sites will be used to develop and modify the task history questionnaire, and statistical analyses will be performed to assess its utility in developing overall exposure profiles. A short questionnaire will be administered before and after each work shift in order to assess the relationship of painting exposures on the incidence of specific symptoms.

### Physiologic Sampler for Airborne Health Hazards

**Researcher:** Michael G. Yost, Ph.D.  
**Affiliation:** University of Washington  
 Seattle, Washington  
**Keywords:** Personal air-sampling pump, physiologic workload, sampler measurement exposure assessment

**Purpose:**  
 To develop a personal sampling pump for industrial hygiene use that samples workplace air in proportion to the physiologic workload of the worker, rather than at a constant flow.

**Abstract:**  
 The objective of this project is to develop and validate a method for measuring workers' exposure to health hazards in the construction industry. Traditional industrial hygiene methods involve the measurement of airborne concentration of a particulate or gaseous contaminant and do not account for the variable rate of respiration of the worker. In construction, the human work load may vary by a large degree during a shift, or a single task. This factor is extremely important in determining the workers' dose of inhaled agent. The

lack of accurate dosimetric measurements causes uncertainty in exposure assessment for hazards such as asbestos, lead and solvent fumes from painting.

The specific aims of this project are to develop a modified air sampling pump whose flow rate is proportional to the worker's pulmonary ventilation rate, and to test this sampler on construction workers in the field. The sampling pump will use an input signal, derived from either heart rate or thoracic dimensions to alter the air flow rate. Thus, the amount of contaminant collected during the sampling period will be proportional to the mass inhaled by the worker. This contrasts with the traditional constant flow sampling methods that give a result proportional to the average ambient concentration of contaminant. The sampler will first be validated in laboratory experiments using volunteers. Once validated in the controlled setting, the device will be placed on selected workers at local construction sites where exposure to paint solvents occurs. Performance of the sampler will be evaluated by taking breath samples from workers at the start of the next shift to estimate absorbed dose. A high correlation between absorbed dose from breath samples, and the physiologic sampler measurement, will demonstrate the effectiveness of the new method.

### Validity Assessment of Self-Reported Construction Tasks

**Researcher:** Katherine L. Hunting, Ph.D.  
**Affiliation:** The George Washington University  
 Washington, D.C.  
**Keywords:** Sheet-metal workers, self-reported exposures, observational data, validity

**Purpose:**  
 To evaluate the validity of self-reported exposures to construction tasks by sheet metal workers.

**Abstract:**  
 This one-year pilot study will evaluate the validity of self-reported exposures to construction work tasks among sheet metal workers. Approximately 100 sheet metal workers will be observed for 3 days. These workers will be asked to complete questionnaires detailing the proportion of time spent at various tasks on the days they are observed and the gauge and dimensions of sheet metal materials handled. Investigators will meet individually with each worker to compare the results of worker-reported versus observational data. Thus, in this study, worker-reported questionnaire data on time spent on tasks will be compared to observational data, and the validity assessed both pre- and post-feedback. The ultimate aim of this pilot study is to develop a valid instrument for the collection of self-reported data on duration of exposure to identified work tasks. Such an instrument would be valuable in future epidemiological studies seeking to identify tasks associated with the prevalence and/or severity of musculoskeletal disorders, and also in the evaluation of intervention studies.

### III. Health Services Research

#### Patterns of Health and Health Service Use in Construction

**Researcher:** John M. Dement, Ph.D.  
**Affiliation:** Duke University  
 Durham, North Carolina  
**Keywords:** Work-related morbidity, health services utilization, workers' compensation insurance, economic model

**Purpose:**

To investigate work-related morbidity among construction workers and the patterns of health services use associated with these work-related conditions as they are covered under workers' compensation insurance and under general health insurance, and to determine how these systems coexist.

**Abstract:**

The proposed cohort study will be conducted over a three-year period and will study health care services issues among construction carpenters and laborers in western Washington. Data used for this study will include union files, occupational demographic data, union based health insurance files, and worker's compensation files from the Washington Department of Labor and Industries. The proposed research will include analyses of the magnitude of costs associated with work-related injuries and illnesses and the distribution of costs borne by injured workers, workers' compensation and private medical insurance. An economic model will be developed for these analyses with inputs consisting of costs due to medical payments, lost work time and decreased future earning power due to permanent partial disability. Long term sequela of serious occupational illness or injury will be assessed through longitudinal analyses of data among the cohorts being studied. These analyses will investigate health care utilization patterns and workers' compensation claims resulting in extended lost work time. Impacts on health care coverage and the family will be assessed through a brief mail questionnaire to be administered to a selected subset of workers with claims for serious work related injuries or illnesses.

### IV. Intervention Effectiveness Research

#### Elevated Blood Leads in the Iowa Construction Industry

**Researcher:** Stephen J. Reynolds, Ph.D.  
**Affiliation:** University of Iowa  
 Iowa City, Iowa  
**Keywords:** Surveillance, epidemiologic analysis, lead exposures, construction workers

**Purpose:**

To conduct surveillance and epidemiologic analyses of occupational lead exposures in the Iowa construction industry.

**Abstract:**

Sentinel data from case reports and surveillance systems strongly indicate that workers in selected construction trades are significantly exposed to lead, are inadequately monitored, and are sustaining serious illness from exposure. This proposed epidemiological study of occupational exposure to lead in the Iowa construction industry

will characterize and compare the prevalence of blood lead concentrations in a random sample of 500 Iowa construction workers representing selected high risk trades including painters, ironworkers, plumbers, pipefitters, laborers, and electrical workers. Questionnaires will be used to identify and evaluate risk factors such as specific tasks, work practices, personal protective equipment, and training. Prevalence results will also be used to evaluate the efficacy of the Iowa Department of Public Health's Adult Blood Lead Surveillance Program, and the University of Iowa Hospitals and Clinics database for identification and control of occupational exposure to lead in the Iowa construction industry. Information generated in this project will be incorporated into the National Hazard Communication Resource Center data base, as well as presented to construction workers. The data generated will be used to plan future projects to evaluate occupational exposure and to develop intervention strategies.

#### Evaluation of Controls Protecting Lead-Exposed Workers

**Researcher:** Lewis D. Pepper, M.D.  
**Affiliation:** Boston University  
 Boston, Massachusetts  
**Keywords:** Lead exposure, bridge construction workers, blood levels

**Purpose:**

To determine why high blood lead levels continue to occur in bridge construction workers despite government regulations and industry recommendations.

**Abstract:**

The overall objective of this project is to determine why high blood lead levels continue to occur in bridge construction workers despite government regulations and industry recommendations. The main goals are to: (1) measure lead particle exposure in three particle size fractions and perform surface wipe measurements for 150 bridge construction workers; (2) perform a set of structured observations of work practices and the use of personal protective devices and control technologies at times coinciding with exposure measurements; (3) perform a project baseline blood lead on this group, followed by a second measurement 14 days later; (4) use ethnographic techniques (observation, questionnaires, and semi-structured interviews) to assess worker and management awareness of lead poisoning issues associated with bridge repair work practices at each site; and (5) develop predictors of blood lead and air concentrations using industrial hygiene controls, work practice, training, company attitude and worker attitude variables. This project is a cross-sectional survey of bridge repair and maintenance workers at work sites in Massachusetts for two years. This will result in a total sample of 150 bridge workers in the survey. Workers will be interviewed, asked to keep a work task diary during a two-week period, blood samples and air samples will be taken to determine individual-level exposures and biological markers of effect. Other information on environmental conditions and work practices will be gathered to construct a personal exposure score which will be used in the analysis. The analysis of the data collected over the two-year period will be focused on associations between specific work activities, environmental factors, blood lead levels and airborne lead levels for bridge repair and maintenance workers.

## Demonstration: Health and Safety Programs in Construction

**Researcher:** Vernon McDougall  
**Affiliation:** UBC Health & Safety Fund  
 Washington, D.C.  
**Keywords:** Carpenters, injuries, health and safety programs

### Purpose:

To demonstrate that injuries to carpenters can be measurably reduced by the implementation of written health and safety programs by small construction contractors.

### Abstract:

Written health and safety programs will be implemented with 25 small construction contractors in the Boston, Mass., Providence, RI and Hartford, Conn., areas. A control group of 50 similar contractors in western Massachusetts and upstate New York will be recruited. Using OSHA-required injury logs and workers' compensation data, this project will seek to demonstrate how the implementation of written health and safety programs by such contractors can lead to a measurable reduction in the rate of occupational injuries. Implementing this intervention over a two-year period is expected to result in a reduction in OSHA-recordable injuries, lost workday injuries, days lost from work due to injuries, and reduced workers' compensation experience modification rates. This project will also seek to demonstrate that the implementation of health and safety programs will result in measurable changes in workplace safety and health practices by participating contractors. Three sentinel safety and health practices will be measured through direct observation in actual workplaces: use of eye protection, use of ground fault circuit interrupters, and use of hearing protection. Contractor and worker interviews will be used to gather information about the implementation of the intervention, and particularly about the perceptions of these two groups regarding the degree of acceptance of the intervention.

## A Participatory Model for Intervention in Construction

**Researcher:** Bryan Buchholz, Ph.D.  
**Affiliation:** University of Massachusetts  
 Lowell, Massachusetts  
**Keywords:** Incidence/ prevalence injuries and illnesses, health and safety programs, participatory model for intervention

### Purpose:

To reduce the incidence and prevalence of injuries and illness for both union and non-union construction contractors using participatory methods of intervention.

### Abstract:

This study's goals are to better understand and describe the barriers to intervention in construction and to propose strategies for intervention. A participatory model for intervention in construction, "Health Trak," will be developed. Health Trak has three key components: (1) participatory meetings with worker and contractor representatives; (2) toolbox meetings with on-site personnel using a checklist that is designed to collect data on worker-identified hazards; and (3) participant observation methods including observation, interviews and focus groups with workers and

management. Qualitative and quantitative evaluation of Health Trak will occur at multiple levels by: (1) surveying the participants on the appropriateness and usefulness of the program; (2) assessing of hazards quantitatively pre- and post-intervention and; (3) evaluating its effectiveness in reducing injuries and illnesses in the construction industry by comparing data for the union contractors utilizing Health Trak with the same data for other large unionized contractors performing nearly identical work. An advisory board will be developed to oversee the project's efforts. Health Trak examines both traditional safety and health-related issues, the focus however, tends to be more on health problems. Ergonomic and industrial hygiene hazards (such as those that may lead to low-back injuries), noise-induced hearing loss, and silicosis are the biggest concerns. The effectiveness of Health Trak in dealing with these hazards will be a priority for evaluation.

## Back Injury Interventions for Small Contractors

**Researcher:** Gary A. Mirka, Ph.D.  
**Affiliation:** North Carolina State University  
 Raleigh, North Carolina  
**Keywords:** Ergonomic interventions, low back injuries, residential contractors

### Purpose:

To study the effectiveness and the efficacy of ergonomic interventions for the reduction of low back injuries in residential contractors.

### Abstract:

Three trades identified in the literature as high risk occupations for low back injury will be the focus of this study: masons, carpenters and roofers. This study will be conducted in North Carolina, a state that is largely non-union. The first phase of this project will be to conduct a symptom survey of a large sample of workers from each of these trade groups to develop a baseline for low back pain symptoms. A subset of these people will then be evaluated with a more in-depth symptoms survey and several simple physical tests. Finally, a stochastic hazard assessment model will be used to quantify the biomechanical demands of these jobs. The second phase of this project will be to develop and implement ergonomic interventions to reduce the biomechanical stress experienced by these workers including-simple engineering solutions, advanced engineering solutions, administrative controls, education and training. The third phase of this project will be to test the effectiveness and efficacy of these solutions. The efficacy of these interventions will be demonstrated through a reduction in the biomechanical stressors present in the worksites and an improvement in the symptomatology reported by the workers in the sample. The effectiveness of the solutions will be evaluated through the use of industry focus groups. The final phase will be a demonstration project that will be conducted on a home site where the solutions developed and evaluated during the course of the project will be displayed for other small residential contractors.

## Loss Education to Reduce Construction Related Injuries

**Researcher:** Pamela S. Kidd, Ph.D.  
**Affiliation:** Kentucky Injury Prevention & Research Center  
 Lexington, Kentucky  
**Key Words:** Economic issues, intervention, safety practices, image simulation

### Purpose:

To test an intervention based on the premise that economic issues impact the acceptance of safety practices by employers, supervisors, and employees.

### Abstract:

In Kentucky, construction accounted for 12.7% of occupational fatalities and \$87 million in worker compensation costs in 1994 and 1995. In this project, the Occupational Injury Prevention Program (OIPP) of the Kentucky Injury Prevention and Research Center (KIPRC) and the Kentucky Employers Mutual Insurance (KEMI) company will test an intervention that integrates aspects of a stress and injury model, narrative learning and empowerment theories. Six reality-based, latent image simulation exercises on the topics of back injury and fall prevention will be developed using epidemiologic data collected in Kentucky. Decreased productivity and the fiscal ramifications of injury will be integrated throughout each simulation. A pre-test/post-test design for experimental and control groups will be used. Companies will be randomly assigned to three study groups: home study (group 1), group sessions (group 2), or control (group 3). Participating companies will receive a 5-10% discount on their worker's compensation premium. Three hypotheses will be tested. First, participants in a fall and back injury prevention training program (groups 1 and 2) will have fewer fall-and back-related injury claims, fewer fall-related fatalities, lower fall-related and back injury rates, and incur less fall-related and back injury health care costs than those who do not participate (group 3). Second, participants in the group format (group 2) training program will have fewer falls, back injuries, fall-related and back injury claims, fall-related fatalities, lower fall-related and back injury rates, less transfer failure, and incur less fall-related and back injury health care costs than those who participate in the home-based (group 1) training program or than those who do not participate (group 3). Third, participants in the group format (group 2) training program will have higher self-efficacy composite scores and organizational climate scores than those who participate in the home-based (group 1) training program. KEMI will utilize aspects of the training program that prove efficacious.

## V. Surveillance Research Methods

### Risk Factors for Injury in Denver Airport Construction

**Researcher:** Kathleen Kreiss, M.D.  
**Affiliation:** University of Colorado  
 Denver, Colorado  
**Keywords:** Airport, epidemiological study, work-related injury, workers' compensation claims, legislative reform

### Purpose:

To conduct an epidemiological study of occupational illness and injury during the construction of the new Denver International Airport.

### Abstract:

The construction of the new Denver International Airport offers the opportunity to describe the epidemiology of work-related injury and illness in road building, subway tunneling, and construction of commercial buildings, such as terminals and concourses. The specific aims are to (1) describe the magnitude and rates of work-related morbidity by trade and project; (2) assess modifiable risk factors for construction-related health problems; and (3) evaluate the impacts on morbidity and costs of an owner-controlled insurance program and workers' compensation reform in Colorado. This study will include: (1) a cohort study of all airport construction workers examining workers' compensation claims as the health outcome; (2) an evaluation of claims rates in relation to contractor characteristics obtained through a cross-sectional interview survey of contractors; (3) a comparison of claims experience from the airport construction with that of Colorado's and the nation's construction industry; and (4) an evaluation of the preventive and economic effects of the legislative reform in Colorado's workers' compensation law that occurred during airport construction. This study will be useful in planning preventive interventions in the construction industry.

## • Disease and Injury

### I. Hearing Loss

#### Preventing Noise-Induced Hearing Loss (NIHL) in Construction Workers

**Researcher:** Sally L. Lusk, Ph.D.  
**Affiliation:** University of Michigan  
 Ann Arbor, Michigan  
**Keywords:** Noise-induced hearing loss, hearing protection, hearing conservation program

### Purpose:

To understand workers' behavior related to the use of hearing protection and how to make their hearing conservation program more effective.

### Abstract:

The purpose of this project is to prevent noise-induced hearing loss (NIHL) in construction workers through improved training in use of hearing protection—training that is based on a conceptual model, specific to construction workers.

The specific aims of this project are to: (1) identify the most important predictors of construction workers' use of hearing protection, specifically for carpenters, operating engineers, and plumbers/pipefitters; (2) use the identified predictors of construction workers' use of hearing protection to adapt the training program to the needs of construction workers; (3) assess the effect of the training program on construction workers' use of hearing protection (HP); and (4) revise the training program as indicated and make it available for general use in training construction workers (CWS).

This study will be conducted with two distinct samples, a regional sample and a national sample, in three phases: (1) a cross-sectional



correlational study will identify predictors of selected CWS' (carpenters, operating engineers, and plumbers/pipefitters) use of HP; (2) a training program prepared for factory workers will be revised to incorporate the predictors of CWS' use of HP and pilot-tested; and (3) the effect of the training program on the use of HP will be measured in both samples.

This study will provide needed data on: (1) the degree of hazardous noise exposure as perceived by CWS; (2) the frequency of use of HP by CWS; (3) the strongest predictors of the use of HP by CWS; (4) the recruitment of CWS into research studies through their training programs; and (5) worker behavior related to personal involvement in safety precautions within a comprehensive health promotion framework. Additionally, the proposed study will result in a customized training program for the prevention of NIHL in CWS through the increased use of personal HP. By developing the individual worker's consistent use of protective equipment, safety measures can be transported from construction site to construction site.

## II. Musculoskeletal Disorders of the Upper Extremities

### Analysis of Construction Tasks for Overexertion Injuries

**Researcher:** John G. Everett, Ph.D.  
**Affiliation:** University of Michigan  
 Ann Arbor, Michigan  
**Keywords:** Overextension injuries, ergonomics, craft workers

**Purpose:**  
 To identify and develop workplace interventions to reduce ergonomic stresses in construction jobs associated with overextension injuries.

**Abstract:**  
 This three-year project will identify specific construction tasks that place craft workers at high risk for overexertion injuries and disorders. The specific aims of this project are to: (1) develop a complete catalog of all construction tasks broken down step-by-step at the Basic Task Level; (2) analyze each task as a whole and each step of each task for the presence of the seven generic risk factors for overexertion injuries, repetitive exertions, static exertions, forceful exertions, localized mechanical stresses, posture stresses, low temperature, and vibration; (3) use the above methods to identify several tasks that expose craft workers to the highest risks for overexertion injuries and develop workplace interventions to reduce ergonomic stresses for those tasks; and (4) quantify or measure the reduction of risk resulting from the interventions in #3 above as prototypes for widespread application of the knowledge gained in #1 and #2 above. The investigators hypothesize that it is possible to identify the underlying causes of overexertion injuries for many specific construction tasks, and that it is technically and economically feasible on many construction tasks to reduce the level of physical demands placed on craft workers. The resulting knowledge will have widespread application in improving occupational health and safety and expanding job opportunities for women, older workers, and construction workers who are partially disabled due to previously suffered overexertion injuries.

## III. Traumatic Injuries

### Effect of Workload on Task Performance on Inclined Surfaces

**Researcher:** Amit Bhattacharya, Ph.D.  
**Affiliation:** University of Cincinnati  
 Cincinnati, Ohio  
**Keywords:** Workload, environmental lighting, postural stability, inclined and elevated surfaces

**Purpose:**  
 To investigate the effects of workload and environmental lighting on postural stability while performing tasks on inclined and elevated surfaces.

**Abstract:**  
 Workers (construction workers, roofers, etc.) who work on elevated and/or inclined surfaces have relatively higher incidences of deaths/injuries due to falls than other work-related causes. This five-year study provides an experimental design that will investigate the interaction between work experience of working on elevated and/or inclined surface, age, sex, and other fall risk factors such as physical workload, standing surface inclination, and environmental lighting. A series of experiments will be carried out with 240 industrial workers (such as roofers, glazers, painters, ironworkers, etc.) with and without experience in working on inclined and/or elevated surfaces to test the following hypotheses. First, that there will be a difference in workload-induced changes in visual spatial perception abilities between the "experienced" workers and the "inexperienced" workers. Second, that the "experienced" workers will have smaller numbers of errors in detecting vertical/horizontal cues after exposure to a workload or while standing on an inclined surface compared to those from "inexperienced" workers. Third, that the workload and poor environmental lighting will have detrimental effects (increase in postural sway variables and/or increase in susceptibility to loss of balance as described by appropriate variables in this application later) on "inexperienced" workers' ability to maintain upright postural balance while performing simulated industrial tasks, as compared to "experienced" workers. Fourth, that the highest level (100 watts) of workload and poor environmental lighting either individually and/or collectively will increase the muscular contraction levels needed to maintain upright balance while performing simulated industrial tasks on inclined surfaces. The "experienced" workers will show lower levels of postural muscular contractions compared to those with no experience. Fifth, that the strategically placed visual cues will significantly improve workers' ability to maintain upright balance after exposure to the highest workload (100 watts) and poor environmental lighting and lower the levels of muscular contractions of the postural muscles. Availability of such data will result in (1) developing planned training programs for new workers who have to perform physically demanding tasks on inclined/elevated surfaces and; (2) determining the need of visual cues to minimize excessive postural muscle fatigue and provide a "safe" upright balance maintenance while working on an inclined and/or elevated surface.

## • Other Research Topics

### I. Human Factors

#### Ergonomics of Task Performance on Slippery Surfaces

**Researcher:** Amit Bhattacharya, Ph.D.  
**Affiliation:** University of Cincinnati  
 Cincinnati, Ohio  
**Keywords:** Slip, risk factors, fall potential

**Purpose:**

To explore the role that surface conditions, lighting conditions, and shoe status play in the risk of slipping and falling.

**Abstract:**

Slipping is often the main factor that contributes to falls that result in injury in about 50% of cases. The proposed four-year study will investigate the interaction between age, sex, and other fall risk factors such as surface slipperiness, shoe wear/tear, and lighting. In the proposed study, gait and postural instability, and fall potential will be evaluated for 94 industrial workers (21 to 70 years of age) doing tasks on a slippery surface. These tasks simulate conditions that occur in nonoccupational and occupational environments while standing or walking on a slippery surface. The proposed study is designed to test the following hypotheses: (1) the subjects' ability to correctly assess the slipperiness of a surface will be impaired if the area is poorly-lit, if the shoe sole surface does not make proper contact and produce sufficient contact pressure, or if the subject is older; (2) these factors will have the greatest impact on the subject's ability to perform the task; and (3) training on a known slippery surface will increase the task performance and reduce the potential to fall. The findings from this study will provide quantitative data regarding how the above risk factors influence fall/slip potential and modify task performance capabilities while working on a slippery surface. The worker-based data from this study will provide guidelines for developing criteria for a minimum shoe-lubricant-flooring coefficient of friction and a shoe replacement strategy necessary to prevent a slip/fall while wearing worn-out shoes and carrying a weight on a slippery surface.

#### Fall Potential of Work on Elevated and Inclined Surfaces

**Researcher:** Amit Bhattacharya, Ph.D.  
**Affiliation:** University of Cincinnati  
 Cincinnati, Ohio  
**Keywords:** Falls, inclined surfaces, elevated surfaces, postural instability, loss of balance

**Purpose:**

To identify specific environmental factors associated with (workplace) falls from inclined and/or elevated surfaces.

**Abstract:**

Falls from elevated/inclined surfaces present significant potential for debilitating accidents causing permanent disability or fatality. This three-year study investigates the interaction between age, sex, and other fall risk factors such as standing surface elevation/inclination,

job task and lighting. In the proposed study, postural instability and loss of balance risk factors will be evaluated for industrial workers' (21 to 55 years of age) performance on test conditions that represent combinations of these risk factors. There are environmental (lighting), job-task (stationary versus dynamic) and personal (age) risk factors that can individually and/or collectively jeopardize one's ability to perform tasks on elevated/inclined surfaces without experiencing postural imbalance and, eventually, a fall. This research may elucidate: (a) how work surface inclinations, elevations, and distractions affect postural balance under conditions of good and poor lighting for various age ranges; and (b) the type and positioning of visual cues beneficial in reducing postural instability while performing simulated industrial tasks on inclined and elevated surfaces. Results obtained from the proposed study with industrial worker subjects will provide the basis for future studies using a larger sample from the worker population. The results from this study will: (a) provide information about the types of visual cues needed to reduce postural instability/propensity of loss of balance (which might put them at a risk of falling) while working on elevated or inclined surfaces; and (b) help develop a statistical model showing the relationship between propensity of loss of balance and the independent variables characterizing the environmental, job task, and personal risk factors. A determination of which of the risk factors need to be corrected to reduce the fall potential will then be possible.

### II. Other Research Topics

#### Lead, Solvents and Neurobehavior in Construction Workers

**Researcher:** Nancy L. Fiedler, Ph.D.  
**Affiliation:** University of Medicine & Dentistry of New Jersey  
 Piscataway, New Jersey  
**Keywords:** Lead, solvents, neurobehavioral impairments, cross-sectional study

**Purpose:**

To test the hypothesis that construction workers exposed to lead and solvents will have more neurobehavioral impairment than workers exposed to lead alone.

**Abstract:**

Construction workers are routinely exposed to neurotoxins with little or no protection or medical monitoring of health effects. The proposed cross-sectional study will compare the neurobehavioral performance of 60 workers in each of four exposure groups: lead (iron workers), lead and solvents (commercial painters), solvents (house painters), and minimally exposed controls (dry wallers). Subjects will be recruited from the Iron Workers Union (IWU) and the International Brotherhood of Painters and Allied Trades (IBPAT). Subjects will be matched across the four groups on age, gender, ethnicity, and baseline ability. The relationship between blood lead, XRF of bone lead, occupational history of solvent exposure, and neurobehavioral performance will be quantified. In year 3, a subset of the most highly lead exposed subjects (N=20) and their minimally exposed controls (N=20) will be followed longitudinally and reevaluated with XRF of bone lead and neurobehavioral performance. It is hypothesized that: workers with the highest levels of bone lead, as an indicator of cumulative exposure, accompanied by a history of chronic exposure to organic

solvents, will have significantly greater decrements in neurobehavioral performance relative to the lead only, solvent only, and minimal exposed control groups.

## Cooperative Agreements

### Prevention Center for Occupational Safety & Health in the Construction Industry

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Prevention, construction workers, surveillance and intervention research

**Purpose:**

To develop a Prevention Center for Occupational Safety and Health in the Construction Industry.

**Abstract:**

The overall goal of the project is to prevent the incidence of work-related fatalities, injuries, illness and disabilities among construction workers through a national program of surveillance and intervention research on safety and health in the construction industry. Within the cooperative agreement are projects being conducted to: characterize the industry and its workforce through prospective and cross-sectional epidemiologic studies; assess exposure and economic factors; identify safety/health risks and the etiology of related disorders through surveillance studies and activities; improve worksite management, tools, materials, supplies and worker training; study the policy-related implications of safety and practices; and disseminate the findings to decision makers who affect safety and health in the industry and other concerned groups. The project will be conducted over five years, using a multidisciplinary team to fulfill the requirements of the cooperative agreement. NIOSH investigators are collaborating with the researchers funded under the cooperative agreement. The focus of 1997 will be to (1) analyze workers' compensation data from the Northwest Laborers' Health and Welfare Fund to assess the relationship between work-related and non-work-related health conditions; (2) analyze construction fatalities from other countries focussing on highway construction and tunneling; (3) refine previously developed task-based approach for exposure assessment and evaluation of engineering controls; (4) develop and evaluate methods to disseminate occupational safety and health information to construction workers and management, e.g., multilingual Hazard Alert Cards; (5) refine and enhance a personal computer software package to review construction site safety requirements and program elements; (6) characterize ergonomic hazards in the construction trades; and (7) develop and test interventions created in response to the identified hazards.

The cooperative agreement with the Center to Protect Workers' Rights in Washington, D.C., funds 10 institutions to conduct consortium projects aimed at issues related to the construction trades.

## The Consortium Projects

### The George Washington University

**For more information contact:**

Laura Welch, M.D.  
200 Eye St., NW  
Room 712  
Washington, D.C. 20037

**NORA Category: Surveillance Research Methods**

Research has focused on protecting the health of construction workers using data from: (1) the George Washington University occupational medical clinic and emergency room, (2) participating occupational medicine clinics in the Association of Occupational And Environmental Clinics, (3) a follow-up study of construction workers with work-related injuries or illnesses, and (4) sentinel health events for which a high incidence can be documented.

### Professional Safety Consultants/ University of Maryland

**For more information contact:**

Ernie Jergenson, P.E., C.S.P.  
P.O. Box 891  
Seabrook, MD 20703-0891

**NORA Category: Other**

The objective of this project is to develop and validate project management software that includes safety and health guidance for use at construction sites to schedule activities.

### University of Massachusetts Lowell/ Public Health Research Institute

**For more information contact:**

David Wegman, M.D.  
Department of Work Environment  
University of Massachusetts-Lowell  
One University Ave.  
Lowell, MA 01854

**NORA Category: Exposure Assessment Methods  
Intervention Effectiveness Research  
Musculoskeletal Disorders of the Upper  
Extremities  
Surveillance Research Methods**

The University of Massachusetts Lowell/ Public Health Research Institute has worked with the Boston Central Artery and Tunnel Project to: (1) identify and evaluate ergonomic risk factors among construction activities, (2) identify and evaluate sources of particulate exposure for construction workers, (3) characterize illnesses and injuries among construction workers, (4) conduct ethnographic analysis of construction work to identify barriers to effective participation in safety and health on construction sites, and (5) disseminate safety and health information in New England.

## Mount Sinai School of Medicine

### For more information contact:

Stephen M. Levin, MD  
10 East 102nd Street  
Box 1057  
New York, NY 10029-6574

**NORA Category: Control Technology and Personal Protective Equipment  
Exposure Assessment Methods**

The purpose of this project is to conduct assessments of control technologies designed to reduce worker exposure during industrial lead abatement with a focus on bridge rehabilitation and renovation. The results of these assessments will form the basis of an analysis of available controls in terms of their applicability to different types of abatement processes and project designs as well as varying project scopes.

## The University of Oregon

### For more information contact:

Steven Heckor, M.S.P.H.  
c/o Research and Sponsored Programs  
5219 University of Oregon  
Eugene, OR 97403-5219

**NORA Category: Intervention Effectiveness Research  
Musculoskeletal Disorders of the Upper  
Extremities**

This program has used the Intel Chip Manufacturing Plant Construction Project, involving 3,000 workers and 100 subcontractors, to develop a model work-related musculoskeletal disorder prevention program that will: (1) track the incidence of work-related musculoskeletal disorders, (2) conduct ergonomic hazard identification, and (3) test interventions, with an initial emphasis on exercise programs.

## The University of Iowa

### For more information contact:

Thomas M. Cook, Ph.D., P.T.  
The University of Iowa  
100 Oakdale Campus, 158C IREH  
Iowa City, IA 52242

**NORA Category: Intervention Effectiveness Research  
Musculoskeletal Disorders of the Upper  
Extremities  
Surveillance Research Methods**

This project has: (1) used emergency room reporting from mostly rural hospitals for surveillance of occupational injuries related to construction; (2) evaluated a participatory ergonomics intervention model for reducing musculoskeletal diseases among construction workers, and identifying barriers to its implementation in the construction worksite; and (3) disseminated safety and health information in Iowa and has developed a global Internet web site for construction safety and health.

## The National Constructors' Association (NCA)

### For more information contact:

Pete Stafford  
Center to Protect Workers' Rights  
111 Massachusetts Ave., N.W.  
Suite 509  
Washington, D.C. 20001

**NORA Category: Surveillance Research Methods**

This program is developing a surveillance system using reports from its member contractors to: (1) identify construction projects with good safety records, (2) develop guidelines on best practices in construction safety and health for distribution to the industry, and (3) disseminate information to the employer community.

## Duke University

### For more information contact:

John Dement, Ph.D.  
Department of Community and Family Medicine  
Division of Occupational and Environmental  
Medicine  
DUMC 3834, Durham County  
Durham, NC 27710

**NORA Category: Surveillance Research Methods**

The objective of this research is to study injuries, illnesses, and mortality among North Carolina construction workers doing predominantly residential and light commercial work. This workforce is mostly non-union.

## The Occupational Health Foundation/ FOF Productions

### For more information contact:

Sandra Tillett  
888 16th Street, NW  
Suite 5350  
Washington, DC 20006

**NORA Category: Education and Training**

This project will develop and evaluate a standardized 30-hour safety and health training program that all 15 building and construction trade unions in the United States and Canada will implement on a nationwide level.

## Health and Safety Interventions in the Construction Industry

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Safety and health practices, planning and management, training, new technologies, information strategies

**Purpose:**

To identify, develop, and implement a best safety and health practices program in the construction industry by evaluating targeted intervention strategies for their effectiveness and applicability to implementation.

**Abstract:**

This program is being conducted in conjunction with many organizations and research facilities including the Center to Protect Workers' Rights (CPWR), Occupational Safety and Health Administration, West Virginia Safety and Health Program, Alice Hamilton Occupational Health Center, Construction and Safety Program of Illinois, Mt. Sinai School of Medicine, NASA Lewis Research Center, Bechtel Construction Company, National Labor-Management Coalition, Cleveland Building and Trade Unions, and USA Casualty. The goals of this project are to develop and implement a nationally coordinated construction industry program. The specific aims of the project are enumerated in the following paragraph.

First, to develop and conduct targeted interventions aimed at reducing the risk in the following high-incidence hazards in construction: falls, electrocutions, dermatitis and lead poisoning. Second, to develop and implement an economic research agenda to characterize the economic structure of the construction industry and to evaluate the cost-benefit or cost-effectiveness of various health and safety interventions. Third, to develop and implement a program of soliciting small intervention studies in order to stimulate the development of innovative pilot programs that can identify future intervention projects with great potential. Fourth, to develop and implement information strategies that will provide the most up-to-date knowledge concerning the safety and health needs of the industry, the best practices presently utilized, and those practices identified through the intervention projects that prove to have promise. In 1997, this program will complete the development of four intervention projects aimed at four high-incidence hazards in construction: falls, electrocutions, dermatitis, and lead poisoning. In addition, it will begin the data collection for the evaluation of these intervention efforts; complete a chart book describing the nature of the construction industry; award three or more small grants for intervention or economic research projects and obtain the final reports for three grants awarded; and complete the development of at least one additional project to examine the underlying economic determinants of safety and health outcomes in one construction industry. Long-term accomplishments are to improve the safety and health of construction workers through evaluating targeted intervention strategies for their effectiveness and applicability.

The CPWR has continued to support the development of standardized, certifiable, safety and health training for all building trade crafts persons, which has been transferred to building trades unions and employers as a joint labor-management initiative now being developed under the guidance of the 1990s Committee (a national joint committee revived by the CPWR as part of this cooperative agreement); expanded a comprehensive information dissemination program; continued the development of their economics research network; initiated in-house economics research activities, including the publication of the *Construction Chart Book*; developed a functional regional labor/management safety and health advisory committee in New England; administered the Small Studies Program; continued to develop a regional network to foster implementation and evaluation of the Lead Specifications Intervention Program; and has taken the lead in cooperation with NIOSH in facilitating the development of a national research strategy with a construction industry intervention focus.

## Small Studies Program Projects

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The Center to Protect Workers' Rights (CPWR) has expanded the focus of their Small Studies Program, which initially targeted surveillance-related pilot and opportunistic studies, to the following prevention research and pilot intervention studies that deal with health and safety in construction:

### The University of Utah

**For more information contact:**

Anthony J. Suruda, M.D., M.P.H.  
Occupational and Environmental Health Clinic  
Department of Family and Preventative Medicine  
Building 512  
Salt Lake City, UT 84112

**NORA Category: Traumatic Injuries**

The University of Utah recently completed a study of fatal injuries involving cranes in the construction industry. The study used OSHA investigation data to characterize crane-related fatalities.

### The Duke University Medical Center

**For more information contact:**

Carol Epling, M.D., M.S.P.H.  
Assistant Clinical Professor  
Duke University Medical Center  
Division of Occupational and Environmental  
Medicine  
Department of Community and Family Medicine  
DUMC Box 2914  
Durham, NC 27710

**NORA Category: Exposure Assessment Methods**

This project measures airborne exposures during drywall finishing and possible lung effects typically characterized as nuisance dust. They will present the results of the pilot and recommendations for controls to reduce exposures to construction unions representing drywall workers.

### The Medical College of Pennsylvania and Hahnemann University

**For more information contact:**

Pete Stafford  
Center to Protect Workers' Rights  
111 Massachusetts Ave., N.W.  
Suite 509  
Washington, D.C. 20001

**NORA Category: Intervention Effectiveness Research**

This program is developing a compliance checklist intended to evaluate the use of contract specifications for the protection of workers from lead on steel structures. The CPWR will use the checklist in evaluating the effectiveness of current lead specifications language.

## The University of Massachusetts - Lowell

### For more information contact:

Bryan Buchholz, Ph.D.  
Assistant Professor  
University of Mass-Lowell  
Department of Work Environment  
One University Avenue  
Lowell, MA 01854

### NORA Category: **Intervention Effectiveness Research Musculoskeletal Disorders of the Upper Extremities**

This program has completed the development of worker-friendly data sheets on commonly used construction materials for on-site use by workers and others in ergonomic job evaluations and remediation of materials handling risks.

## Hunter College of CUNY

### For more information contact:

Mark Goldberg, M.D.  
Assistant Clinical Professor  
The Mount Sinai School of Medicine  
Box 1057  
One Gustave Levy Place  
New York, NY 10029-6574

### NORA: **Other**

The Hunter College program has made recommendations based on a completed study of fire and explosive hazards and of airborne exposures encountered by metal polishers during their use of solvent and water-based strippers and lacquers in elevators and other settings.

## East Carolina State University

### For more information contact:

Marjorie Baldwin, Ph.D.  
Associate Professor of Economics  
East Carolina State University  
Economics Department  
A 430 Brewster Building  
Greenville, NC 278-4353

### NORA: **Other**

East Carolina University is using the data set of Ontario workers' compensation claimants to study the impact of injuries on the employment of construction workers.

## Intervention Projects

### Built-Right, Inc. (PALM)

#### For more information contact:

Albert Creswell  
414 Walnut Street  
Suite 500  
Philadelphia, PA 19106

### NORA Category: **Intervention Effectiveness Research**

This program has developed an owner-union-employer intervention, Safetrack, in the renovation and construction of petrochemical facilities.

### The Occupational Health Foundation The Operative Plasterers' and Cement Masons' International Association FOF Productions

#### For more information contact:

Sandra Tillett  
888 16th Street, NW  
Suite 5350  
Washington, D.C. 20006

### NORA Category: **Allergic and Irritant Dermatitis**

The Occupational Health Foundation has developed intervention programs directed at reducing dermatitis among construction workers. These programs include: development of a tool box pamphlet on preventing contact dermatitis; in-depth trainee follow-up focus group sessions; in-depth interviews with experts; development of a draft protocol for experiments in innovative controls; and evaluation of the contact dermatitis nationwide worker training program.

### Construction Safety Council of Illinois

#### For more information contact:

Thomas A. Broderick, M.I.S.  
4415 West Harrison Street  
Suite 407  
Hillside, IL 60162

### NORA Category: **Education and Training**

This project is designed to reduce the incidence of electrocution injuries by workers directly touching an energized line or indirectly when the construction equipment or material which they are in contact with become energized by touching the line.

## West Virginia University

**For more information contact:**

Mary Jane Buckland  
PO Box 6845  
886 Chestnut Ridge Road  
Morgantown, WV 26506-6845

**NORA Category: Intervention Effectiveness Research  
Traumatic Injuries**

West Virginia University will develop and implement Fall-Safe, an intervention program target at fall protection in the construction industry.

## Conceptual Arts, Inc

**For more information contact:**

Pierce H. Jones, Ph.D.  
PO Box 14608  
Gainesville, FL 32604

**NORA Category: Intervention Effectiveness Research**

Conceptual Arts, Inc., has continued the development of a personal computer-based hazard communication system for use on construction sites and will implement the system and test its acceptability among construction workers.

## Washington State SHARP Program

**For more information contact:**

Paula Coleman  
United Brotherhood of Carpenters  
Health and Safety of North America  
101 Constitution Ave., NW  
Washington, D.C. 20001

**NORA Category: Education and Training  
Intervention Effectiveness Research  
Musculoskeletal Disorders of the Upper  
Extremities**

**Keywords:** Musculoskeletal disorders, hazards, interventions, training, ergonomics

**Purpose:**

To develop training materials for construction to integrate ergonomic principles into practical work practices.

**Abstract:**

Working closely with three contractors and with researchers at the Washington State SHARP (Safety and Health Assessment and Research for Prevention) program, the United Brotherhood of Carpenters developed training materials and methods applicable to construction. By evaluating exposures, work practices and new tools, training was developed for concrete formwork, drywall, and interior work that integrated ergonomic principles into practical work practices. Ergonomics training was conducted for contractors, most of the apprentices in Western Washington, and Apprenticeship Instructors across Washington State. These training materials also were used in another construction cooperative agreement. Training effectiveness was evaluated through a pre- and post-training test and the use of problem-solving exercises.

University of Massachusetts-Lowell/  
Massachusetts General Hospital Program**For more information contact:**

David Wegman, M.D.  
Department of Work Environment  
University of Massachusetts-Lowell  
One University Ave.  
Lowell, MA 01854

**NORA Category: Exposure Assessment Methods  
Musculoskeletal Disorders of the Upper  
Extremities**

**Keywords:** Whole body vibration, evaluate, field test, heavy construction equipment

**Purpose:**

To evaluate whole body vibration among operating engineers of heavy construction.

**Abstract:**

Massachusetts-Lowell and Massachusetts General Hospital collaborated on a cooperative agreement that evaluated whole body vibration (WBV) among operating engineers of heavy construction equipment. The researchers were able to develop, field test, and refine methods for measuring WBV in heavy construction vehicles. A program for transforming WBV data for analysis was developed and validated for data collected in different types of heavy construction equipment and terrains.

Greater Cincinnati Occupational Health  
Center Program**For more information contact:**

Margaret Atterbury, M.D., M.P.H.  
311 Howell Avenue  
Cincinnati, OH 45220

**NORA Category: Education and Training  
Musculoskeletal Disorders of the Upper  
Extremities**

**Keywords:** Musculoskeletal disorders, carpenters, medical evaluation, ergonomic training

**Purpose:**

To characterize work-related musculoskeletal disease among carpenters and to develop interventions to reduce exposure and prevent illnesses and injuries.

**Abstract:**

In an effort to characterize musculoskeletal disease among carpenters, the Greater Cincinnati Occupational Health Center administered questionnaires to 560 union carpenters, 100 of which were also given a physical exam. Additional longitudinal medical evaluations (including nerve conduction studies) will be completed during 1997. Ergonomic exposures of the back and shoulder were characterized using a dosimeter and methods developed by the Center. In 1997 methods to evaluate upper extremity exposures will be developed and an intervention based on a screw gun modification evaluated. Three papers have been submitted for publication, additional data analysis will be completed in 1997. A major focus of the final year is to facilitate a construction labor management partnership to foster use of ergonomic training programs developed for apprentices and journeymen and to promote the integration of ergonomic training to construction sites. The

results of this project will benefit the United Brotherhood of Carpenters and other construction trade organizations and contractors and will provide both NIOSH and the Occupational Safety and Health Administration (OSHA) with useful documentation of ergonomic hazards and potential interventions in the workplace.

### Connecticut Road Industry Surveillance Project (CRISP)

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**NORA Category:** Intervention Effectiveness Research  
Surveillance Research Methods

**Keywords:** Lead, bridge sites, statewide surveillance

**Purpose:**

To monitor and reduce lead exposure at bridge sites and to develop a statewide surveillance program to monitor blood lead levels in workers.

**Abstract:**

The Connecticut Road Industry Surveillance Project (CRISP) is a cooperative agreement with Yale University that was begun in 1990 and involves collaboration with the Connecticut Departments of Health Services and Transportation. The two principal objectives were to develop: (1) medical and environmental specifications (e.g., medical examinations and industrial hygiene) for monitoring and reducing lead exposures at bridge sites; and (2) a centralized, statewide surveillance system to monitor blood lead levels in workers. A 12-month extension was awarded to CRISP.

## Research Opportunities Requests for Applications

### Intervention Research Grants in Construction Safety and Health

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Prevention, work-related injuries and diseases, construction

**Purpose:**

To demonstrate the effectiveness of policies, regulations, education and training, government and private outreach programs, and new technology in preventing disease and injury.

**Abstract:**

NIOSH is interested in projects that will facilitate progress in preventing adverse effects among construction workers and new technologies for controlling hazardous substances. As such, NIOSH is soliciting grant proposals to demonstrate the prevention of work-

related diseases and injuries in the construction industry by designing, implementing, and evaluating measures to reduce occupational hazards. If prevention measures are not currently available, new technologies need to be developed for controlling hazardous exposures. Such new technologies must be evaluated to determine that the prevention measures are feasible, even for smaller businesses. Intervention research, of which control technology is a part, examines the utility and impact of new and existing preventive measures in the workplace. Assessments are needed of the effectiveness of regulations, educational efforts, government and private outreach programs, employer policies, worker training, and protective technology in preventing disease and injury. A project that is proposed to develop or test the efficacy of an intervention should be designed to establish, discover, develop, elucidate, or confirm information relating to occupational safety and health, including innovative methods, techniques, and approaches for solving occupational safety and health problems. A project that is proposed to demonstrate the effectiveness of an intervention should address, either on a pilot or full-scale basis, the technical or economic feasibility of implementing a new/improved innovative procedure, method, technique, or system for preventing occupational safety and health problems. A demonstration project should be conducted in an actual workplace where a baseline measure of the occupational problem will be defined, the new/improved approach will be implemented, a follow-up measure of the problem will be documented, and an evaluation of the benefits will be conducted. Control technology research, a form of intervention research, seeks to prevent work-related diseases and injuries by designing, implementing, and evaluating measures to reduce occupational hazards at their source. In reviewing its National Program for Occupational Safety and Health in Construction, NIOSH has found that solutions to problems often exist (tools, technology, and best safety practices), but they are not adopted at the workplace. Effective interventions can lead to reduced injury and death rates.

## Intramural Research Projects

### • Research Tools and Approaches

#### I. Cancer Research Methods

### Asphalt Fumes: Study of First-Stage Lung Cancer Biomarkers

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Asphalt fumes, biomarkers, cancer

**Purpose:**

To study changes in potential first-stage lung cancer biomarkers due to asphalt fume exposures.

**Abstract:**

Exposure of workers to fumes generated from asphalt pose a potential risk for cancer in occupational settings. These fumes contain both particles and vapors. Lung cells from rats will be exposed to asphalt fumes or chemical extracts *in vivo* by inhalation and during *in vitro* culture. After exposure, the following measures



will be assessed: the generation of free radicals as measured by luminol-enhanced chemiluminescence; cytochrome P450 levels; oncogene expression measured by molecular biology procedures; and cellular DNA adduct formation. This project investigates the complex interplay between mixed exposures in the workplace and cancer risk.

### Asphalt Fume Fractionation and Identification of Genotoxic Components

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Asphalt fume, cancer, carcinogen

**Purpose:**

To identify specific components of asphalt fume and fume fractions that may be responsible for the observed tumorigenicity in previous studies.

**Abstract:**

Two previous NIOSH-sponsored research studies investigated the tumorigenicity of roofing asphalt fume and fume fractions upon application to mouse skin. These studies concluded that exposures to asphalt fumes pose an increased potential carcinogenic risk. As a follow-up to these studies, this project will identify specific components that may be responsible for the observed tumorigenicity in the previous NIOSH investigation. Active fume fractions from the previous investigation will be further fractionated, analyzed, and bioassayed to identify the specific components. This research will result in the development of sampling and analytical methods for these specific components that may be carcinogens in asphalt fume. In related research, asphalt fume will be collected, at asphalt paving hot mix plants, from conventional asphalt formulations and from the same conventional formulations but with the addition of scrap rubber tires. These asphalt fumes will be evaluated for mutagenicity with the spiral plate Ames test. Results of analyses will be evaluated according to the criteria described in the plan of experimentation developed for this project and the NIOSH Quality Assurance Manual. Impact will be determined by examination of trends in the selection and modification of asphalt paving materials that minimize risk.

## II. Control Technology and Personal Protective Equipment

### Anthropometry of Construction and Agriculture Populations

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Human sizing data, anthropometry

**Purpose:**

To reconstruct human images in a database to develop facial and hand models for designing construction tools and eye/head/face/hand protection apparatus.

**Abstract:**

A state-of-the-art 3-D laser scanning system will be utilized to scan and reconstruct human images in the database. This data will initially be used to develop optimal facial and hand models for designing construction tools and eye/head/face/hand protection apparatus, such as eye goggles, helmets, masks, gloves, and protective clothing. The study results can be extended to: (1) develop optimal whole-body models for designing fall-protection equipment; (2) evaluate personal protective equipment (PPE) usage among female construction workers; (3) determine the optimal clearance of roll-over-protection-structure for farm tractors; (4) determine the optimal height and step clearance for construction vehicles; (5) determine the optimal width of ladders and optimal distances among ladder rungs; (6) provide fundamental information for evaluating human biomechanical stresses at workplaces; (7) enhance computerized human modeling applications for evaluating high-risk job activities, such as operating machines or working at elevation, thus reducing involvement of human subjects in studies of hazardous environments. The human size data for protective clothing is 57 years old and based on military personnel. This project will develop a standardized procedure for computerized anthropometric measurement, including establishment of sampling strategies. The final products will be databases of agricultural and construction workers for use in developing improved designs for equipment and personal protective equipment.

### Development of Extension Ladder Foot Slip Prediction Model and Test Model

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Simulation skid test, method development

**Purpose:**

To examine extension ladder foot slippage under simulated conditions.

**Abstract:**

In the construction industry, 11 percent of the 250 fatal falls and 20 percent of the 210,000 lost workday cases due to falls from elevation involve falls from ladders. This is an experimental laboratory-based project to examine extension ladder foot slippage under a variety of simulated anticipated conditions of use. An experimental test system will be designed and constructed. The system will consist of a moveable force platform upon which a variety of representative surfaces will be attached to replicate surfaces that ladder-foot mechanisms would typically be resting on during use. The ladder feet will be placed on the test surface. The platform will be moved incrementally in a direction perpendicular away from the wall that the top of the test ladder will be positioned against. This will provide a method for varying the ladder angles to the point where foot slippage occurs. Variations in use conditions and ladder configurations will be considered in the overall protocol design. The use conditions that may be examined include load placement, upper resting surface conditions (e.g., wood, aluminum, brick, or rollers to negate friction effects), foot resting surface (e.g., concrete, asphalt, packed dirt, sand, wood, tile, etc.), and possibly dynamic loading (either simulated or using actual human subjects). The ladder configurations may include foot types, ladder length, ladder extension position, ladder types (i.e., IA, I, II, or III), and ladder material (wood, aluminum, fiberglass, etc.).

## Electrical Injury Protection System

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Electrical contact, approach warning,  
fast tripping electrical protection

### Purpose:

To develop an electrical injury protection system that provides body approach warning and rapid cutoff with electrical contact for electrical construction workers who work around low voltage power.

### Abstract:

The proposed system is composed of a portable detector that is carried by the electrician, a controller near the electrical power source, and an electronic triac power-source breaker that is controlled by the controller. The electrodes of the detector used as both the transmitting/receiving antenna and shock potential pick-up are attached to the worker's body. The detector continuously broadcasts a low intensity coded RF signal through the worker's body. If the worker is too close to a live wire, an appropriate amount of the RF signal arrives to the wire and is coupled to the controller. If the intensity of the RF signal received by the controller is high enough, this RF signal activates the controller to transmit a frequency-modulated RF signal through the live wire to the detector. An audible signal is in turn generated by the detector with different pitches to warn the worker that he/she is too close to a live wire. When an electric shock occurs, the detector electrodes pick up the human body potential generated by the electric shock. This shock potential immediately activates the detector to transmit a special coded RF signal that immediately activates the controller to cut off the power source. This system will be used by electricians, maintenance workers and other workers who work around a low voltage (< 500 V) live electrical system and have a high risk of electrical injuries and fatalities. In the construction industry, approximately 120 workers are electrocuted annually.

## Dynamic Scaffold Modeling for Fall Protection

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Scaffolding, fall arrest anchorage

### Purpose:

To investigate whether scaffolding provides sufficient stability to be used as an anchorage in a fall arrest system.

### Abstract:

This project will investigate whether scaffolding has sufficient stability to be a fall protection anchorage in the absence of an anchorage to a permanent structure. Proposed OSHA regulations will require that fall protection be available during erection and dismantling of scaffolding. Accompanying nonmandatory recommendations are to provide guidance on how such fall protection could be achieved. One method of providing fall protection would be to tie off to scaffolding in the absence of an anchorage to a permanent structure. This project will use laboratory

investigations and possibly computer modeling to determine those conditions, if any, under which scaffolding can be used as an anchorage. Input will be sought from external partners, including OSHA and scaffold manufacturers, erectors, and users, for the test protocol development. This input is expected to include the types of scaffolding and styles of scaffold construction to be tested, the methods of simulating a falling worker or workers, the fall conditions to be simulated, and the human and non-human loading of the scaffold (for example, other workers and bricks) in addition to the load imposed by the fall.

## Assessment of Hazardous Waste Abatement Workers' Workload

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Energy expenditure, oxygen uptake, waste abatement

### Purpose:

To determine the energy expenditure required to perform selected waste abatement tasks.

### Abstract:

Results of previous NIOSH studies showed that work/rest recommendations might be impossible to design because of the wide variation of physiological responses among test subjects. Microcooling systems might be a solution to protect workers who need to wear protective clothing in hot environments. Such systems would help maintain core temperature and heart rate at acceptable levels, thus allowing workers to better cope with critical amounts of metabolic and environmental heat. Microcooling systems capabilities must be adapted to the environmental and metabolic heat load of the workers. It is critical to assess the energy expenditure involved to perform selected tasks. The goal of this project is to measure the average energy expenditure of a selected number of typical activities such as shoveling, carrying loads, etc., in nine subjects. Six activities have been selected for study. The evaluations will take place in the Human Factors Laboratory, in the new NIOSH facility, and will be performed with a recently acquired portable oxygen analyzer. During all tests, the regular respiratory mask will be replaced by a face piece connected to an integrated telemetry system monitoring several physiological parameters including heart rate and oxygen consumption. Knowing the oxygen consumption required to perform a given task, the amount of energy expended during this particular activity can be easily deduced since the consumption of 1 liter of oxygen per minute translates into a 5 kilocalories per minute energy expenditure, or a 350-watt workload. A precise knowledge of the energy expenditure required to perform a given task is needed to select the best microcooling system for this particular task.

## Evaluation of a Portable X-Ray Fluorescence (XRF) Unit for Air Sample Screening

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Welding, metals, x-ray fluorescence spectrometer

### Purpose:

To evaluate the applicability of a portable X-ray fluorescence spectrometer for on-site analyses of air filters to estimate occupational exposures to welding fumes and other airborne metals.

### Abstract:

Approximately one million workers are employed full-time as welders worldwide. During workplace operations, they are potentially exposed to hazardous chemicals, including the oxides of iron, manganese, nickel, chromium, lead, zinc, copper, and cadmium, and, consequently, suffer a number of respiratory diseases, including metal fume fever, hypersensitivity pneumonitis, chronic bronchitis, siderosis, neoplasms, and occupational asthma. Obtaining timely exposure assessment data in rapidly changing workplaces, like construction sites, has been hampered by the lack of cost-effective and practical measurement techniques. This project aims to examine the applicability of portable XRF technology as a screening tool for exposure assessments for welders in construction sites and workers in other workplaces where metal-containing aerosol particles may pose a hazard. Complete success in this project will lead to commercial production of relatively low-cost, portable XRF devices that will be used in characterizing airborne metal concentration in order to facilitate the reduction of exposures to acceptable levels.

## Slope Stability Hazard Reduction

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Slope stability, slope monitoring, open pit, highwall, landslide, slope failure, geotechnical

### Purpose:

To develop methods for reliable assessment of slope stability and determine the corrective measures necessary for reducing associated hazards.

### Abstract:

One of the most unpredictable hazards associated with surface mining is failure of slopes. Stockpiles, waste dumps, tailings impoundments, and open-pit mine highwalls are examples of slopes that may fail. While some of these failures can be predicted or controlled by preventive measures, many slopes still fail each year. The purpose of this project is to develop methods for reliable assessments of slope stability and determination of corrective measures for reducing slope failure hazards at mining operations. In addition, the exposure of workers to hazards associated with installation of supports and instruments at potentially dangerous slide areas will be studied, and alternative methods of installation will be explored. Results of this research may be transferable to a

number of other civil engineering construction projects, such as roadcuts, railroads, canals, refuse disposal sites, and earth dams.

## Monitoring System for Mine Hoisting

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Hoisting, mine shafts

### Purpose:

To improve the safety of hoist and elevator operations in mine shafts by using sensor and computer technology.

### Abstract:

The goal of this project is to improve the safety of hoist and elevator operations in mine shafts by using sensor and computer technology to increase the amount and efficiency of information flow available to hoist operators and inspectors. The project was initiated at the request of the Mine Safety and Health Administration (MSHA) because of increasing concern about hoist and elevator safety. Deficiencies in safety and control features for hoisting miners and materials will be determined. Sensor technology has been developed for maintenance, operation, and inspection activities. Such technology will enable researchers and others to evaluate what conditions and equipment should be monitored, how conditions crucial to safe operations can be sensed, and how the information collected can be processed and acted upon. Extensive laboratory and field evaluations of this technology are underway to ensure that the devices will function as required. Some of the approaches being developed will have direct application to cranes used in the construction industry.

## Hazard Reduction for Surface Mining Equipment

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Heavy equipment, alarms, economics, jarring and jolting

### Purpose:

To reduce haulage-related accidents and injuries at surface coal and metal/nonmetal mines.

### Abstract:

The project addresses three issues: hazard recognition, operator safety, and economics of safety. The hazard recognition, or proximity warning, task will investigate the usefulness of alarms such as Doppler radar for drivers of large trucks. Because of the massive size of haulage trucks and the harsh conditions under which such trucks operate, equipment modifications may be necessary. Laboratory and field tests on off-road haulage trucks are scheduled. The operator safety task will continue characterization of jarring and jolting accidents and will be focused on defining and isolating elements that could lessen shock loads to an operator. Laboratory tests will be initiated using an MTS shock test frame equipped with seats. The economics-of-safety task will be directed to quantifying

costs associated with surface mining activities. Initially, researchers will study various truck dumping procedures and will focus on comparing the costs of end-dumping materials over a spoils pile versus dumping and bulldozing materials over a dump edge. The results of this project will be used to reduce accidents and fatalities associated with large, mobile equipment in surface mines.

### Safe Monitoring of Cable Bolt Roof Supports

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Bolt support systems, load monitoring

**Purpose:**

To develop a device for monitoring cable bolt support systems as they are used in both mining and civil engineering.

**Abstract:**

A device for monitoring cable bolt support systems as they are used in both mining and civil engineering will be developed in carrying out this project. Monitoring devices should function in extreme environments (hot, cold, wet, and dirty) where shear stresses can be quite high. These devices should also meet the standards set by regulatory agencies in those instances where such devices are regulated. Although the primary setting for the use of cable bolts is in mines, other settings include tunnels, highway overpasses, and bridges, so safe ways to monitor cable bolts could have application beyond the mining industry.

### Dust Control Technology Directed Towards Eradication of Silicosis in Surface Mining Operations

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Silicosis, surface operations, silica dust

**Purpose:**

To eradicate silicosis in all surface operations through evaluation of multioccupational dust sources and current control technologies, sample variability, drilling parameters, and testing of new control technology.

**Abstract:**

This 3-year project will provide a broad-based approach towards the reduction and prevention of silicosis in surface operations through evaluation of multi-occupational dust sources and current control technologies, sample variability, drilling parameters, and testing of new control technology. The first phase of the project will access silica dust sources and current control technology utilized at surface mines. The second phase of the project will research deficient areas of surface mine dust control technology. Since rock drills are expected to be the most significant silica source, the major area of technology development will likely focus on reducing the amount of silica dust generated from the drilling operation. Dust source surveys will be conducted at surface mines with poor and good dust

compliance sampling histories. The mines to be surveyed will be selected with the assistance of the Mine Safety and Health Administration (MSHA) health specialists at district offices. Sampling will be focused on sources associated with occupations historically identified by NIOSH that contract silicosis and sources identified by MSHA as having a high risk of exposure to quartz. These sources are likely to include the drill, dozer, pan, and truck operations. An analysis will be made to identify the effectiveness of the dust controls used at the various operations surveyed. Silicosis disease information will be compiled from the Institute and occupational dust compliance data will be compiled from MSHA Health Specialists to identify surface mine occupations exposed to high levels of silica dust.

### Evaluation of Substitute Materials for Silica Sand in Abrasive Blasting

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Silicosis, crystalline silica, quartz, abrasive blasting, substitutes

**Purpose:**

To collect technical, economic, and health-related data about silica sand and ten substitutes for silica sand in abrasive blasting. Results of the study will advance efforts to protect workers from silicosis by helping the users and others identify appropriate substitutes for silica sand in abrasive blasting.

**Abstract:**

Abrasive blasting occurs in a number of construction tasks such as bridge construction and maintenance (painters and special trade contractors), precast concrete construction, and tank construction. This project collects technical, economic, and health-related data about silica sand and ten substitutes for silica sand in abrasive blasting. In the first phase of the research, scientists simulated abrasive blasting in an environmentally controlled laboratory setting. Individually, 41 grits were applied to a row of steel plates at identical pressures. The laboratory research allowed NIOSH to collect consistent data on the performance of the materials, avoiding random factors that could make it difficult to compare and analyze the findings. The health-related data being gathered in the study include: airborne respirable quartz concentrations, airborne elemental concentrations, airborne radioactivity concentrations, and total dust concentrations. The economic and technical data being gathered in the study include: price per ton of delivered material, blasting rates (ft<sup>2</sup>/min.), recyclability, consumption rates (lb/min.), disposal costs, total operating costs, profile established in the surface blasted, cleaning standard established by the blast, embedment, and water soluble contamination. The laboratory simulations, now completed, will be followed by field research at a selected site. Eight different types of abrasives used in the laboratory setting will be applied at identical pressures in the field research. With a consistent baseline, the field research will then help researchers identify factors that could influence the performance of the materials in real-life applications.

## Implementation of Engineering Control Technology Research

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Engineering Controls, design manuals

### Purpose:

To facilitate the acceptance and publication of successful engineering control designs into design manuals, handbooks, and other standards.

### Abstract:

This project will identify successful engineering control technologies highlighted in past and present research and compile the design information into a form suitable for inclusion in control design manuals, handbooks, and other standards such as the American Conference of Governmental Industrial Hygienists Manual on Industrial Ventilation and the American National Standards Institute's Industrial Ventilation Standards. The project will also provide an overview of the NIOSH control technology design and intervention studies to assure the studies provide control technology information in the appropriate form for inclusion in these documents and for use by the engineering control designer.

## Control of Occupational Exposures During Construction

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Engineering controls, drywall finishing, asphalt paving, asphalt roofing

### Purpose:

To facilitate engineering control design, identification, and implementation and to improve health-related worker training.

### Abstract:

Under the NIOSH construction initiative and through partnerships with labor and industry representatives, this project investigates the availability of engineering controls for identified construction processes. Commercially-available controls will be evaluated for performance efficiency in a controlled environment, then field-evaluated controls will be evaluated for worker acceptance and field performance at active construction sites. Successful results will be disseminated to labor, industry, equipment manufacturing, and the occupational safety and health profession. In this project NIOSH collaborates with its external partners for each construction process under evaluation. This partnering aspect ensures that construction process knowledge will be incorporated into the engineering controls research and it facilitates the dissemination of results throughout the affected industry. To date, research activities have engaged control technology issues associated with drywall sanding, rebar tying, asphalt paving (highway-class pavers), and asphalt roofing kettles. Future activities will continue the focus on asphalt paving, expanding beyond the highway-class paver category into smaller paving machines as well as some types of paving-support equipment.

## Control Technology for NIOSH Surveillance Activities

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Engineering controls, SENSOR, carbon monoxide, CO, silica

### Purpose:

To identify and/or develop engineering controls to minimize the incidence of injury/disease identified by surveillance activities.

### Abstract:

This project is the intervention component to NIOSH surveillance activities. It provides assistance to state health departments that are involved in the SENSOR program. The project identifies and/or develops engineering controls to minimize the incidence of injury/disease identified by surveillance. Field studies are conducted to evaluate, recommend, or develop control technologies. Recent construction-related research activities include the evaluation of control technologies used to reduce exposures to silica and other particulate during rock drilling operations. Current research efforts have been focused upon the reduction of carbon monoxide (CO) poisonings associated with the use of small internal combustion engines within confined environments. In 1992, CO was responsible for 867 nonfatal and 32 fatal work-related poisonings. Many poisonings occurred within the construction industry when small gasoline-powered engines were used indoors in poorly ventilated areas. Technical feasibility of retrofitting an engineering control on a 5-horsepower, Briggs and Stratton gasoline-powered engine is under current development. The control will consist of one or more CO sensors, located near the engine, the worker, or both to activate an engine shutoff based on instantaneous or integrated CO concentration. This control technology could be used by contractors and equipment manufacturers to reduce CO poisonings. Results will be distributed to State Health Departments, equipment manufacturers, and labor organizations and articles will be written in professional and trade publications.

## Control of Airborne Emissions During Welding Operations

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Engineering controls, welding, pipe fitting

### Purpose:

To reduce welder exposures to fumes and gases, either through local exhaust ventilation or through modification of the process, without affecting the quality of the weld.

### Abstract:

This study addresses the need to protect workers from fumes and gases generated during welding processes. The 1990 Census of Population estimates there to be over 600,000 welders and cutters in the United States. The Department of Labor's Bureau of Labor Statistics (BLS) indicated in a 1978 study that over 50% of injured welders were employed in manufacturing; welders in construction

accounted for another 18%. Insufficient ventilation was the most common unsafe condition reported at welding work sites. Fumes and gases have long been recognized as potential health hazards to welders. The amount and type of fume produced during welding operations is dependent on the welding process, the composition of the base metal and electrode, the shielding gas, and the presence of surface coatings or contaminants on the base metal. This study is being conducted to reduce welder exposures to fumes and gases, either through local exhaust ventilation or through modification of the process, without affecting the quality of the weld. The project scope is to evaluate arc welding processes such as shielded metal arc welding (SMAW), gas metal arc welding (GMAW), and flux-cored arc welding (FCAW). In-depth studies will be conducted to develop information on effective control technology to reduce worker exposures to welding fumes. This will include evaluations of new technologies such as low-fume generating electrodes, and local exhaust ventilation systems such as fume extraction guns. Many of the newer welding technologies are primarily used within the manufacturing industry however their exposure reduction potential could reduce welding fume exposures in the construction industry.

### Applied Monitoring Studies (Carbon Monoxide (CO)/Instrument Shutoff Device)

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Carbon monoxide (CO), carbon monoxide shutoff, gasoline-powered engines, small engines, carbon monoxide poisoning

**Purpose:**

To demonstrate the feasibility of incorporating a shutoff on equipment run by small gasoline-powered engines.

**Abstract:**

Hundreds of work-related deaths or illnesses due to carbon monoxide (CO) occur each year in the United States. The shutoff on equipment run by small gasoline-powered engines will consist of a carbon monoxide sensor and a complementary mechanism for either truncating the flow of gasoline, or killing the spark, hence stopping the engine when the sensor sees a predetermined ambient CO concentration. Laboratory research will be conducted to demonstrate the principle, with field trials following. The ultimate goal is for manufacturers to make an engineering design change incorporating the CO shutoff in small gasoline-powered engines. Researchers from NIOSH will collaborate on this effort and they will collaborate with sensor and small engine manufacturers. Currently, construction workers who use equipment powered by small gasoline engines are at risk of carbon monoxide poisoning and, possibly, death. This project addresses the need for an engineering solution to excessive exposures to CO generated from equipment run by small gasoline-powered engines.

### III. Exposure Assessment Methods

#### Improved Exposure Assessment to Prevent Musculoskeletal Disorders in Construction Tasks

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Ergonomics, musculoskeletal disorders, ergonomic exposure assessment, construction tasks, back injuries, knee injuries

**Purpose:**

To develop improved and broader-based exposure assessment methods for construction tasks requiring repetitive, stereotyped motions.

**Abstract:**

Construction workers, e.g., brick layers and drywall installers, experience high rates of musculoskeletal disorders as a consequence of the repetitive work tasks they perform. Alternative exposure assessment tools and new approaches for prevention are needed in this industry because the unstructured and adverse environment of construction make it difficult to apply standard exposure methodologies. Construction tasks also are comprised of multiple exposures such as repetitive motions of the upper and lower extremities, lifting, and activities involving high metabolic demands, the effects of which are not able to be appraised with any single existing exposure assessment methodology. The objective of this project is to evaluate a variety of exposure assessment tools for the construction industry and identify those that are best suited for analyzing construction tasks. Assessment tools will include the Strain Index, OWAS, UM Job Analysis Guidelines and various hardware devices that measure angles and forces. The end product of this effort will be improved exposure assessment for the variety of musculoskeletal stressors found in construction tasks that will provide a means for prevention through early detection of hazards and serve as a metric for evaluating the effectiveness of subsequent intervention efforts aimed at reducing hazards.

#### Summary of Blood Lead Monitoring Evaluation Project

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Lead, workplace, evaluate, intervention

**Purpose:**

To determine if exposure measurement data can be effective in evaluating work practice exposures, performing surveillance, and intervention designed to reduce employee exposure to lead.

**Abstract:**

This project has initially identified three exposure monitoring approaches that are less invasive than the venipuncture technique used to assess blood lead levels and may improve the ability to evaluate workplace exposures to lead. These methods are intended

to be convenient, low-cost, and provide rapid results. The three methods to be evaluated are (1) blood lead levels as analyzed by new field-portable instrumentation and finger-prick blood sampling, (2) saliva as a short-term indicator of lead exposure, and (3) hand lead contamination detection. Method 1 and 2 are less invasive than those used traditionally. Method 3 evaluates ingestion for which there is no standardized measurement technique. The ultimate goal of developing these methods, in addition to providing preferable methods for employers and agencies performing routine lead exposure surveillance, is to measure the effectiveness of lead exposure reduction interventions. During 1997, laboratory and field evaluation of at least one new method for monitoring lead will be completed.

### Exposures Among Asphalt Pavers

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Asphalt, feasibility studies, exposure assessments, evaluation of methods

**Purpose:**

To investigate health hazards to workers exposed to asphalt modified with tire crumb.

**Abstract:**

This is a collaborative study between NIOSH, the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) to investigate health hazards from asphalt modified with tire crumb rubber (CRM). CRM is an emerging technology in the paving industry. National legislation (PL 102-240) that requires the use of tires in paving asphalt has been stayed until the potential health effects of CRM-asphalt have been evaluated. Additionally, exposure to CRM-modified asphalt that results in different levels of Polycyclic Aromatic Hydrocarbons (PAH)-DNA adducts and other biologic changes than occurs with conventional asphalt is being investigated. NIOSH is participating in the exposure assessment and refining analytical methods for PAHs. Three field surveys were completed in 1995-96; a final survey is planned during 1997. Data analyses and a final report will also be completed during 1997.

### Lead Exposures During Residential Paint Abatement

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Lead, exposure assessment, industrial hygiene, field sampling and data analysis

**Purpose:**

To collect data about workers exposed to lead during hazard abatement activities.

**Abstract:**

Residential lead hazard abatement is a growing industry for which little is known about occupational exposures. The objective of this study is to collect data about worker exposures to lead during specific hazard abatement activities. Such information will be useful

for determining the appropriate level of worker protection requirements, including respirator usage, protective clothing, and personal hygiene practices. Several partners are involved in this project including the University of California-Berkeley, the Alameda County Health Department, and Rhode Island Department of Health. Specific objectives include: the evaluation of short-term, task-based lead exposures versus full-shift exposures; the measurement of surface lead contamination to assess the potential for ingestion and/or take-home exposures; and the assessment of employer compliance with OSHA requirements for worker training, exposure monitoring, medical surveillance, protective equipment, and a personal hygiene program. Three surveys will have been completed during 1995-96; another is planned in 1997. Field sampling and data analyses will be completed in 1997. Recommendations for future actions will be provided in a written report of study results.

### Aerosol Sampler Development

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Fibers, aerosol, lung disease, dust, fiber length classifier, respirable and inhalable samplers

**Purpose:**

To improve the design of a fiber length classifier and to develop improved respirable and inhalable samplers.

**Abstract:**

This project incorporates two areas of aerosol sampler research that are both strategic to future exposure assessments within the construction industry. A new type of instrument, a fiber length classifier, was developed in a previous project that opens up a range of fiber research possibilities. It allows vastly improved investigation of fibers that can cause lung diseases, including cancer. The first part of this current project is to improve the design of the classifier and make the design available to other researchers. Collaborations supported by this research have been established within NIOSH to determine the in vitro toxicity of fibers as a function of fiber length and with the Health and Safety Executive in the United Kingdom (UK) to provide them with the classifier technology and to develop a personal thoracic sampler for fibers. The thoracic sampler will replace the current sampler, which has been demonstrated to have problems with sample uniformity and losses in the inlet in a previous project. Research on aerosols, especially fibers and dusts, is essential for improving estimation of worker exposure risk, and evaluating aerosol control system effectiveness. Fibers are an important commercial material and new fibers, such as refractory ceramic fibers, are being used extensively in a wide range of products. With a better understanding of fiber toxicity as a function of fiber length, it may be possible to design safer fibers or use the fibers more safely. The second part of this project involves the evaluation or development of improved respirable and inhalable samplers. More accurate total and respirable dust samplers will help in better assessment of workplace exposure and improved evaluation of dust control system effectiveness. Total dust samplers currently used in the United States have been shown to be inefficient for large particles that can exhibit respiratory system toxicity. Studies of inhalable dust samplers recently performed by the European Community indicate that there are more accurate samplers available. These samplers need further evaluation and development before incorporation into

NIOSH sampling and analytical methods. The sampling efficiency of several commercial samplers mounted on a mannequin will be evaluated in a large wind tunnel. The wind tunnel will be improved to allow accurate estimation of air flow around the mannequin as well as providing a uniform dust cloud for sampler testing. Several aspects of the samplers, including inlet efficiency, internal sampler losses, capture of very large projectile particles, and filter weighing accuracy will be addressed.

### Analytical Method for Total Isocyanate in Air

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Isocyanate, foam insulation, rigid foam, asthma, durable coatings, paints, adhesives

**Purpose:**

To develop methods to assess worker exposure to the total isocyanate group and to evaluate control technologies.

**Abstract:**

Exposure to isocyanates is a major cause of occupationally-induced asthma, therefore, monitoring worker exposure to isocyanates is of great interest to NIOSH field divisions. Approximately, 300,000 U.S. workers were regularly exposed to isocyanates through the production of isocyanate-based products, such as rigid foams for insulation, flexible foams, and durable coatings, paints and adhesives. Some of these exposures also occur as the result of use of these isocyanate-based products, such as in the construction industry, the mining industry and the auto body repair industry. This project addresses a continuing need of NIOSH field divisions for a sampling and analytical method to measure all forms of airborne isocyanate exposure. Moreover, usage of isocyanates has expanded since 1983. Isocyanates to which workers are exposed include monomers and higher molecular weight oligomers. Traditional analytical methods for isocyanates are limited to determining monomer because they require analytical standards for identification and quantification. To assess the extent of exposure to non-monomeric isocyanate species and the degree to which these species contribute to the health effects observed in workers, an analytical method must be developed which enables determination of these species without requiring analytical standards for each individual species. The methods to be developed in this project will enable the assessment of worker exposure to total isocyanate group and will also enable the evaluation of control technology effectiveness.

### Field Methods for the Analysis of Airborne Particulate Lead

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Lead, airborne lead, chemical spot testing, portable analytical methods

**Purpose:**

To develop and evaluate field-portable techniques for the detection and determination of airborne lead and other potential sources.

**Abstract:**

Lead poisoning is an occupational hazard to more than one million workers in the U.S. Since conditions at construction sites can vary widely and change quickly, field-portable screening and analytical methods for lead are needed so that on-site workplace hazard assessments may be conducted rapidly. Chemical spot test kits and portable instrumentation are being evaluated for their use in the on-site detection and measurement of lead in airborne particulate samples. Thus far, a chemical spot test kit has been successfully used to detect lead in air samples, and sampling methods for lead in surface dust and paint have been studied in this project. Also, methods for field analysis have been shown to perform equivalently to lab-based analytical methods for lead in reference materials and in laboratory-generated air samples. The extension of the methods from environmental media (for example, air or soil samples) to biological samples such as blood and saliva are planned. The ability to conduct on-site lead determinations in both environmental and biological samples is possible with the portable electroanalytical instrumentation under evaluation. This project applies state-of-the-art analytical techniques for the determination of airborne lead in the workplace and continuation of the project is planned to extend the work to evaluation of the technology to other matrices besides workplace air; namely, surface dust and paint. This project's collaborations with researchers throughout NIOSH as well as with researchers at National Institute for Standards and Technology (NIST), Environmental Protection Agency (EPA), and other agencies have led to further advancements in portable analysis techniques.

### Field Methods for Hexavalent Chromium

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Chromium, hexavalent chromium, Cr(VI), portable analytical methods

**Purpose:**

To develop an analytical method to be used in the field for identifying hexavalent chromium.

**Abstract:**

Hexavalent chromium, Cr(VI), is a human carcinogen that is present in many workplaces in structural materials, building components, coatings, and pigments. While chromium (Cr) may possess valence states 1-6, it is the hexavalent (chromate) species that is most threatening to human health. Hexavalent chromium may become airborne if materials containing this species are disturbed during work practices such as welding or abrasive blasting. Air particulate containing Cr(VI) can therefore be inhaled by workers performing these work activities, with the risk of subsequent deleterious health effects. Existing methods for chromium determination are laboratory-based, and include methods for total chromium as well as Cr(VI). While all of these methods are useful for the measurement of chromium species in workplace air samples, none are readily field-portable. To help reduce worker exposure to this compound in temporary workplaces, such as construction or demolition sites, and



reduce the corresponding related health effects, field-based analysis methods are needed to determine the levels of exposure and effectiveness of controls. An electroanalytical procedure is planned for the determination of hexavalent chromium in workplace air, since electrochemical instruments are highly sensitive and can be readily made field-portable. Extraction of hexavalent chromium from industrial hygiene samples will be accomplished by the use of ultrasonic energy and basic buffer solution. By using a battery-powered, hand-carryable electroanalytical device, it should be possible to determine Cr(VI) over a wide range of concentrations. Specific electrochemical techniques to be investigated have been used successfully for laboratory-based determination of Cr species in environmental and performance evaluation samples. Recoveries of Cr(VI) from field samples and subsequent electrochemical determination will be evaluated using reference laboratory methods.

### Method Development for Fungi Involved in Occupational Diseases

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Fungi, bird droppings, bat droppings, histoplasmosis, histoplasma capsulatum

**Purpose:**

To develop a method to detect specific fungi in occupational settings.

**Abstract:**

NIOSH has received numerous inquiries and has been actively engaged in Health Evaluations pertaining to worker concerns involving *Histoplasma capsulatum*, *Cryptococcus neoformans*, *Blastomyces dermatides*, and *Coccidioides immitis* associated with bat and bird droppings or contaminated soil in various occupational settings. The extent of occupational risk in these work environments is unknown as no fast, specific, sensitive, relatively inexpensive analytical methods are available for the detection of these particular fungal pathogens. Outbreaks of mycotic diseases among construction workers continues to be reported as a result of demolition of contaminated buildings (MMWR 1995) and related activities. Inhalation of spore-containing dust often contaminated with bird or bat droppings is the primary cause of these diseases. The efficacy of various technologies and methods for preventing these infections has not been adequately evaluated. Fast, inexpensive, specific fungal analytical methods would permit the detection of these fungi in soil and bird and bat droppings. The efficacy of various disinfectants could then be evaluated as well as environmental control measures such as dust suppression methods.

### Analytical Methods for Organic Compounds

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Diesel exhaust, analytical methods

**Purpose:**

To develop, test, and publish analytical methods for characterizing occupational exposures to hazardous substances.

**Abstract:**

This project will develop, test, and publish analytical methods for characterizing occupational exposures to hazardous substances. The need for such methods is constantly changing as hazards are recognized and new technologies emerge. The methods typically involve collection of airborne substances from the worker's breathing zone by a sampling device and subsequent sample recovery and analysis, usually in the laboratory. Substances are selected for method development based on assessment of user (public) needs; needs arising from NIOSH research, field studies, or document development; and needs of regulatory agencies such as Mine Safety and Health Administration (MSHA) and the Occupational Safety and Health Administration (OSHA). Completed work is documented, reviewed, and published as appropriate in the NIOSH Manual of Analytical Methods (NMAM) and the peer-reviewed literature. The time required for a method development can vary from months to years, depending on factors such as sample stability, the need to resolve interferences, and the completeness of the method evaluation. Specific activities related to the construction industry include: (1) Development and implementation support of NMAM method 5040, Elemental Carbon, for field studies to assist the development of NIOSH recommendations for exposure standards to diesel exhaust, and (2) investigation of the applicability of a new analytical technique called capillary electrophoresis (CE). This relatively new technique offers advantages of minimal solvent consumption, requirement of only a very small amount of sample, and resolution of many more analytes.

### Silicosis Risk in the Construction Industry

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Silicosis, crystalline silica, quartz, construction, respiratory disease, lung disease

**Purpose:**

To identify segments of the construction industry/occupations in which an overexposure to respirable silica dust is likely; to document exposure levels in as many construction occupations and settings as possible; and to disseminate the findings from this work in an understandable and instructive form.

**Abstract:**

This project concentrates on obtaining information on crystalline silica dust concentrations during various construction tasks in order to determine occupations in which construction workers may be at elevated risk of developing silicosis. Site visits are used to gather information on exposures and controls. This information is used to qualitatively verify existing OSHA inspection data. Information is disseminated through NIOSH publications such as the brochure: "Construction Workers: It's Not Just Dust! . . . Prevent Silicosis" and the ALERT: "Request for Assistance in Preventing Silicosis and Deaths in Construction Workers."

## IV. Intervention Effectiveness Research

### Job Stressors and Health and Safety Outcomes for Construction Workers

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Job-related stresses, noise induced hearing loss, construction workers

**Purpose:**

To assess job-related stressors and their health and safety outcomes among women and men employed in the construction industry and to design an innovative intervention to increase a worker's use of hearing protection.

**Abstract:**

The activities for this project include:

The identification of job-related stressors and health and safety outcomes among female and male construction workers is the goal of this project. During 1996 interviews were completed for the 200 female and 200 male construction workers and preliminary data analysis was conducted. Data analyses will be completed in 1997. Specific activities involve assessing individual and organizational level job stressors and determinants of health and safety outcomes among construction workers. The results from this study will be used to develop theory-driven interventions to reduce job-related stress and its negative consequences.

The development of innovative interventions to reduce noise induced hearing loss is the goal of this program to increase worker's use of hearing protection by realistically portraying how certain aspects of life can be affected due to a noise induced hearing loss (NIHL). An audiotape was developed to illustrate how difficult listening to music would be if one sustained a NIHL. This tape was played for a labor/management health and safety committee at Baker Concrete. Helpful suggestions were provided by both labor and management and management made a commitment to partner with NIOSH on this project. Pilot intervention studies will be conducted. The audiotape may prove an innovative addition to a larger hearing conservation program.

Results from these activities could be used by the Occupational Safety and Health Administration's (OSHA's) Advisory Council on Construction Health and Safety and should be beneficial in creating a healthier and safer construction workforce.

### Preventing Falls in Mining and Related Industries — A Systems Approach

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Fall injuries, STFs, system intervention

**Purpose:**

To determine the efficacy of a fall prevention program designed to accommodate the hierarchy of controls in highly variable work places.

**Abstract:**

This three-year field research project is focused upon protecting miners (and others who work under highly variable environmental conditions) from injuries related to slips, trips, and falls. The project goals are: (1) to develop a systems-oriented prevention program that considers all factors in the traditional hierarchy of controls; (2) to field test this module at selected work sites in the United States; and (3) based upon field test results to distribute the resulting intervention package to industry. The work will begin with a comprehensive literature review and analysis of official statistics in order to assess potential risk by occupational or areal categories. Next, researchers will use workplace observations conducted by industrial engineers, interviews of employees regarding their slip and fall experiences, and worker self-reporting techniques to establish a data baseline for three cooperating sites: (1) an underground bituminous coal mine in the eastern U.S.; (2) a surface mine in Pennsylvania's anthracite region; and (3) a large re-manufacturer of heavy truck parts. These baseline data will guide the development of the systems intervention. The resulting program is expected to include bio-mechanical and workplace design elements as well as organizational, behavioral, and educational components. Finally, the program will be evaluated in terms of efficacy and universality in reducing injuries from slips and falls.

### Respiratory Disease Health Hazard Evaluation and Technical Assistance

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Respiratory health hazard evaluation

**Purpose:**

To provide information to employees, employers, and employee representatives about the results from NIOSH evaluations of occupational hazards that may cause respiratory disease.

**Abstract:**

Recent initiatives have been in the areas of occupational asthma due to exposure to isocyanates, silicosis (sandblasters, drillers), mining, and construction. Current projects include underground mining and railroad construction. This project provides a mechanism to obtain a scientific and professional evaluation of those agents or working conditions for which Occupational Safety and Health Administration/ Mine Safety and Health Administration (OSHA/MSHA) have no standards or for which OSHA/MSHA standards may not be protective for all workers. This process provides a way for requestors to profit from NIOSH research and recommendations on potential health hazards of immediate concern to them. The NIOSH project officer normally contacts the requestor, the employer, and the local union representative (if any) to discuss the request and plan a visit to the workplace to evaluate the potential hazard. One or more methods of investigation might be used: (1) direct observation and evaluation of production processes and employee work practices; (2) measurement of air contamination levels, and extent of employee exposures; (3) medical tests or physical examination of employees; (4) private, confidential

interviews with employees; and (5) review and evaluation of the employer's records of injuries and illnesses (OSHA logs), employee exposures, medical tests, and job histories. The Health Hazard Evaluation (HHE) Program is designed to evaluate new or unique types of hazards, or common hazards that are not completely understood. When an evaluation is completed and all information and data have been analyzed NIOSH issues a public report of its final determination, giving findings and recommendations.

### Targeted Actions to Prevent Silicosis (TAPS)

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Silicosis, crystalline silica, quartz, respiratory disease, lung disease

**Purpose:**

To discover where silicosis is a problem and determine what interventions can be done to prevent new cases.

**Abstract:**

The Targeted Action to Prevent Silicosis (TAPS) is based on the premise that egregious exposures to crystalline silica, well in excess of allowable limits, continue to occur, especially in small businesses that do not have the resources to devote to health and safety. Operations associated with silicosis have three commonalities: lack of training or awareness, lack of environmental oversight, and lack of chest X-ray screening. TAPS is a silicosis intervention project that entails identification of egregious exposure situations, an assessment of the scope and magnitude of the problem for each situation identified, and action to prevent silicosis (e.g. training, enforcement, and/or X-ray screening). Previous work has identified silicosis in sandblasters and rockdrillers, both of which are used in a variety of construction situations. Feasible medical screening of high risk construction workers will be performed.

### Construction- Related Health Hazard Evaluation (Rapid Response)

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Assistance, employees and employers, workplace conditions

**Purpose:**

To evaluate health hazards in the construction industry and respond to requests for assistance from employers, employees, employee representatives, other Federal agencies, and state and local agencies.

**Abstract:**

NIOSH is mandated under Section 20(a)(6) of the Occupational Safety and Health (OSH) Act to respond to requests for assistance from employers, employees, employee representatives, other Federal agencies, and State and local agencies. The Agency has responded to approximately 100 requests for Health Hazard Evaluations (HHEs) in the construction industry since the inception of the

program in 1970. Over the last few years the program has been receiving about 15-20 construction-related HHE (Health Hazard Evaluation) requests per year. These HHEs have dealt with a wide variety of exposures and emerging occupational problems in the construction setting, including asbestos, asphalt paving and roofing compounds, lead compounds, noise, silica, welding, fly ash, isocyanates, and other organic compounds. NIOSH's response to a request for assistance results in an evaluation of whether chemical, biological, physical, or other agents are hazardous as used or found in the workplace, and the development of control procedures, improved work practices, and medical programs to reduce exposures and prevent adverse health effects. The results of individual evaluations may trigger wider studies and collaborative research efforts (both intramurally and extramurally) of similar exposures in other settings, or may stimulate recommendations for implementation or modification of health standards. The project's goal is to respond to all requests for assistance and conduct site visits, where appropriate. Additionally, HHEs concerning the hazards associated with modified asphalt road paving operations are performed as part of an interagency agreement with the Department of Transportation. The asphalt paving research involves intramural and extramural collaborative research components.

## V. Surveillance Research Methods

### Monitoring System for Human Responses to Workplace Conditions

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Video, EMG, Synchronization

**Purpose:**

To synchronize the human posture video signal with the electromyographic signal, oxygen consumption, and carbon dioxide generation signals.

**Abstract:**

Technologies to measure human responses to workplace conditions (e.g. video analysis, heart rate monitoring, electromyography examination, and others) have been widely used to obtain specific stress exposure of a worker to a job, but very few methods have been developed to identify the critical task elements that contribute to the overall stress exposure. The purpose of this project is to develop an integrated multiple-channel monitoring system to monitor human stress exposure in real time. The system should allow researchers to oversee, quantify, and correlate the subjects' job activities and stress exposures by video, electromyography, heart rate, energy consumption, and other measurements in a real-time and synchronized manner. The activities that results in significant physical stress can be determined objectively in real time and thereby engineering control strategies can be implemented efficiently to control the stress exposure. The monitoring system will be used in safety and ergonomics projects to collect and identify the critical task elements that contribute to the overall stress exposure of a worker to a job. It is invaluable for field and laboratory studies in evaluating biomechanical, physiological, behavioral stresses as well as their interactions.

## Construction Safety Research Development Project

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Research concept, development, construction industry

### Purpose:

To identify safety research needs in the high risk construction industry using surveillance data and meetings with individuals in the target industry.

### Abstract:

NIOSH staff will develop three specific research concepts in each of three high-risk construction industries (e.g., residential building contractors) through a series of one-day facilitated meetings. Selection of the three construction industries will be based on review of fatal and nonfatal injury data. Each meeting will involve 15 to 20 participants from union and nonunion labor, major and small companies, safety and health professionals, insurers of construction companies, and owners of construction sites (construction users) who will each identify research areas that NIOSH could address to reduce acute traumatic injuries in their sector of the construction industry. The meetings will be held in Pittsburgh, PA, and will be conducted with the assistance of a professional facilitator (external to NIOSH), a NIOSH Total Quality Management (TQM) facilitator and a recorder.

## National Traumatic Occupational Fatalities (NTOF) Surveillance System

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Surveillance, fatal occupational injuries

### Purpose:

To provide a national fatal occupational injury surveillance system.

### Abstract:

Approximately 18 percent of the annual work-related fatalities occurring in the U.S. are within the construction industry. The National Traumatic Occupational Fatalities (NTOF) surveillance system project provides a nationwide surveillance system for fatal occupational injuries. Through the purchase and automation of all U.S. death certificates for those who died from a work-related injury, NIOSH is able to describe the national and state-specific nature, magnitude, risk, and characteristics of fatal occupational injuries. NTOF data are continuously analyzed to describe work-related fatal injuries at the national and State level, and for specific industries, occupations, and causes of death. NTOF data are used to identify potential risk factors, set occupational injury prevention priorities, monitor trends over time, and provide quantitative data for national safety policy. These findings are disseminated through journal articles, NIOSH Alerts, and scientific presentations and are used by numerous State and Federal agencies and academia to support occupational injury prevention research and programs.

## Fatality Assessment and Control Evaluation (FACE) Project - Technical Assistance

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Occupational fatality injuries, site investigation

### Purpose:

To combine surveillance and site investigation of select occupational fatalities to develop recommendations for the prevention of similar incidents.

### Abstract:

To date, over 248 individual Fatality Assessment and Control Evaluation (FACE) investigations have been conducted in the construction sector. This project is designed to prevent fatal work injuries by identifying work situations at high risk for fatal injury and developing prevention strategies for those who can intervene in the workplace. Through on-site fatality investigations, agent, host, and environmental data from the pre-event, event, and post-event phases of the fatal incident are collected via a case-series design to facilitate descriptive analysis of selected occupational fatalities (falls from elevations, machine-related, logging). The resulting analyses identify factors contributing to these fatalities and aid in the development of recommendations for preventing similar deaths. The results of the FACE investigations are disseminated through NIOSH Alerts and technical reports, peer-review and trade journals, and presentations.

## State-Based Fatality Surveillance Using the Fatality Assessment and Control Evaluation (FACE) Model

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Occupational fatal injuries, site investigation

### Purpose:

To identify and conduct epidemiologic studies of fatal occupational injuries.

### Abstract:

The State-based Fatality Assessment and Control Evaluation (FACE) program is an extramural program of identification and epidemiologic investigation of selected fatal occupational injuries. The FACE project is designed to prevent fatal work-related injuries through an integrated program of surveillance, on-site investigation, and dissemination and prevention activities. The project is implemented through cooperative agreements with health departments in 14 states. State-based FACE identifies cases through active surveillance of all external causes of occupational death. In-depth evaluations of risk factors are conducted for targeted categories of fatal injuries as determined by national and regional priorities. Detailed epidemiologic data are collected on the circumstances of selected fatalities through on-site investigations, using a standardized investigation protocol. Agent, victim and

environment data are evaluated in relation to the pre-event, event and post-event phases of the incident. Case identification coupled with on-site case investigation yields more detailed data than normally produced through surveillance alone. Because the project is state-based, the resulting recommended preventions will be readily adaptable to specific regional needs and rapidly disseminated to the audience able to implement workplace controls. To date, over 185 individual investigations have been conducted in the construction industry through the state-based FACE program.

### National Surveillance of Non-Fatal Occupational Injuries Using the National Electronic Injury Surveillance System (NEISS)

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Surveillance, non-fatal, occupational injury

**Purpose:**

To provide a national non-fatal occupational injury surveillance system.

**Abstract:**

This project provides a non-fatal occupational injury surveillance system that is nationally representative, timely, and allows for analysis of narrative data, case identification, and the conduct of telephone investigations. This is accomplished using the NEISS surveillance system through an Interagency Agreement between NIOSH and the Consumer Products Safety Commission (CPSC). The use of NEISS as an injury surveillance tool is cost effective because the surveillance system is already established and maintained by CPSC, with a well-documented sampling methodology. The NEISS data are collected from hospital emergency department records. Work-related injury case data for all workers are transferred to NIOSH on a monthly basis. The hospitals participating in NEISS were selected from a stratified probability sample of all hospitals in the U.S. and its territories. Each work-related NEISS record contains information on the characteristics of the victim (e.g., age, sex, race), the injury or illness (e.g., diagnosis, body part injured), source of injury, injury event, and a narrative description of the industry, occupation, and how the injury occurred. NEISS is the only national population-based injury surveillance system whose case-capture method is not restricted by legal jurisdiction, number of lost-days-from-work, age of the injured worker, size of business, and type of industry or occupation (inclusive of public administration, agriculture, self-employed, and volunteers of organized groups, i.e., firefighters, hospitals, and social services) and provides case identification for detailed epidemiologic followup telephone investigations. Based on NEISS data, approximately 10 percent of the work-related injuries treated in U.S. emergency departments are in the construction sector. The potential for gleaning injury risk information from NEISS telephone investigations is virtually unlimited. In 1997, data are being collected for all workers at 65 of the sampled hospitals and telephone surveys are being conducted for construction workers treated for fall-related injuries and for workers treated for eye injuries.

### Environmental Hazard Surveillance

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Surveillance, hazard surveillance, environmental data, respiratory disease, lung disease

**Purpose:**

To review and evaluate environmental data in relation to respiratory disease.

**Abstract:**

This project provides the means of gathering environmental exposure data related to lung disease for the construction industry. It responds to the need for (a) review and reporting of environmental data and (b) development of hazard surveillance information and techniques relevant to respiratory disease agents. The sources of exposure data include National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), and Mine Safety and Health Administration (MSHA). Environmental hazard surveillance data is used in a variety of reports including the Work-Related Lung Disease Surveillance (WoRLD) Report and is used by NIOSH investigators and others to obtain a better understanding of particular respiratory exposures. This data is often used as a basis for environmental investigations.

### Construction Trades Surveillance: Proportionate Mortality Ratio Studies

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Awareness, hazards, health and safety programs, construction workers, work-related injuries, proportionate mortality rate

**Purpose:**

To increase the awareness of construction workers as to the hazards of their occupations and promote implementation of health and safety programs to reduce work-related injuries and diseases.

**Abstract:**

All 15 Building and Construction Trades Departments (BCTD) of the American Federation of Labor-Congress of Industrial Organizations (AFL-CIO) are being studied to examine cause-specific mortality. Unions were prioritized for study based on the numbers of workers potentially at risk, the nature of the exposures, the expected frequency or rarity of health outcomes, and previous studies. Proportionate mortality ratio studies completed at NIOSH include: Laborers, Operating Engineers, Ironworkers, and Roofers. Projects currently underway at NIOSH include Teamsters, Electrical Workers, Sheet Metal Workers, and Bricklayers. Death information and work history records were obtained from the International Union offices. The study results may lead to new hypotheses which can be further investigated via case-control or other appropriate study methodologies. The results of all studies will be published in peer-reviewed journals, technical publications, and discussed with members and health and safety officers from each Union. In 1997, it

is anticipated that this program will (1) complete analyses for roofers and dissemination and publication of study results; (2) complete data collection and updating of the file of Operative Plasterers and Cement Masons; (3) begin a case-control study of stomach cancer among carpenters; and (4) evaluate feasibility of a case-control study of bone cancer and leukemia among operating engineers.

### Construction Trades Surveillance: Mortality Study of the Teamsters' Union

**For more information contact:**

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Proportionate mortality ratio study, excess risks  
for death, union, surveillance, construction industry

**Purpose:**

To establish a surveillance base to identify and reduce hazards and risks for construction industry workers.

**Abstract:**

This project is a proportionate mortality ratio study using the death benefit and membership records of the Central States Teamster union. It will analyze underlying causes and contributing causes of deaths. Short-term, the project will identify excess risks for death in the union that can be used for intervention strategies; long-term, the project will provide a surveillance base critical to identifying targeted areas that impact on the high societal costs of illness and disease in the construction industry. During 1997, this program will initiate contact with union officials, develop a protocol, obtain necessary information, and develop the necessary software programs for data entry, verification, and quality control.

### Construction Trades Surveillance: Mortality Studies of the Electrical Workers' Union

**For more information contact:**

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Excess risks, death, electrical workers

**Purpose:**

To identify excess risks for death and to describe the magnitude of any excess risk for electrical workers on construction sites.

**Abstract:**

This study is a proportionate mortality ratio study of the International Brotherhood of Electrical Workers membership. The project will evaluate the mortality patterns of 30,000 members of the International Brotherhood of Electrical Workers (IBEW) union who died between 1982 through 1989 and who worked in the construction industry. This study will result in increased prevention and intervention efforts to reduce occupational disease and injury. The findings may be relevant to the electromagnetic field and leukemia/brain cancer issue and occupational exposure standard. The findings of the study will be shared with the union, the associations, industry user groups, contractor associations, and others.

### Construction Trades Surveillance: Mortality Study of the Sheetmetal Workers' Union

**For more information contact:**

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Surveillance, sheet metal workers, mortality

**Purpose:**

To conduct a proportionate mortality ratio study of construction workers who were members of the Sheet Metal Workers International Association.

**Abstract:**

This is a proportionate mortality ratio study of construction workers who were members of the Sheet Metal Workers International Association. This national union has a membership of approximately 100,000 workers. The study examines mortality among 14,000 sheet metal workers who died during the years 1980-1991. Data from the union and state health departments have been gathered, coded, and computerized for proportionate mortality ratio (PMR) analysis using the NIOSH lifetable program. Results from this study can be used to suggest hypotheses regarding excess mortality among sheet metal workers which may be further investigated by hazard surveillance. Targeted interventions may be developed based on information resulting from this research.

### Construction Trades Surveillance: Mortality Study of the Bricklayers' Union

**For more information contact:**

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Bricklayers, hazards, risks, mortality, surveillance

**Purpose:**

To conduct a proportionate mortality ratio study of bricklayers to improve information for surveillance and to reduce hazards and risks for construction industry workers in the bricklayers' union.

**Abstract:**

This project is a proportionate mortality ratio study using computerized death benefit and membership records and data tapes. The project will identify excess risks for death in the International Union of Bricklayers and Allied Craftsmen (IUBAC) that can be targeted for intervention strategies and those that need further research. Long-term, the project will assist a national union with the development of an in-house mortality surveillance program. The study population is approximately 10,400 deceased members of the IUBAC. Published data indicates members may experience the increased risk of: cancer of the trachea, bronchus and lung, laryngeal cancer, asthma, bronchitis, emphysema, cancer of the stomach, mental disorders, alcoholism, diseases of the respiratory system, skin, and subcutaneous tissue, and external causes of injury and poisoning. NIOSH will use this study to suggest hypotheses regarding excess mortality among approximately 75,000 IUBAC members, encourage development of intervention/prevention programs, and help the union establish a surveillance program.

## Adult Blood Lead Epidemiology and Surveillance Program (ABLES)

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Blood-lead, surveillance, state-based

### Purpose:

To eliminate exposures which result in workers having blood lead concentrations greater than 25 micrograms per deciliter of blood.

### Abstract:

The Adult Blood Lead Epidemiology and Surveillance Program (ABLES) is a national model for the development of state-based surveillance. The surveillance of elevated blood lead levels provides the public health community (local, state, federal) with essential data for monitoring adult lead poisoning and for setting priorities for in-depth research, intervention, and information dissemination. The blood lead reports received through ABLES cover all lead-exposed workers; about 35 percent of the reports are for construction workers and about 20 percent are from small businesses such as radiator repair shops and battery recycling operations. ABLES is a surveillance system for identifying cases of elevated blood lead levels among U.S. adults. ABLES blood lead level results are reported quarterly in CDC's Morbidity and Mortality Weekly Report. Twenty-five state programs collect blood lead level data from local health departments, private health care providers, and from both private and state reporting laboratories. State ABLES programs use ABLES data to: (1) conduct follow-ups with physicians; (2) target on-site inspections of work sites; (3) provide referrals to cooperating agencies in the event regulatory action is necessary; and (4) conduct hazard surveillance to identify workplace exposure problems and control technology solutions. Findings from ABLES data have been used to identify high risk industries, occupations, and tasks, including: radiator repair shops, battery recycling operations, and construction-related jobs such as bridge repair and home remodeling. State educational materials on lead are disseminated via the NIOSH home page. The ABLES program is conducted in collaboration with many NIOSH programs and 25 state health departments. During fiscal year 1995, 16,809 adults with blood lead levels of 25 ug/dL or greater were identified by the ABLES programs in the 25 collaborating state health departments. When extrapolated to the entire U.S., this would indicate that more than 26,000 adults had blood lead levels 25 ug/dL or greater and, of these, over 5 percent had levels 50 ug/dL or greater. The cases identified through the ABLES program are used by officials from the 25 collaborating States to identify and target high risk industries and occupations for outreach and intervention. The cases are also used by occupational safety and health agencies for referrals for consultation and enforcement. NIOSH is the only Federal supporter of occupational surveillance for lead. Extramural support is currently provided to projects focusing on surveillance enhancement and intervention effectiveness research to reduce adult lead poisoning, which is the most important ABLES activity, by helping to achieve the 25 ug/dL. The Healthy People 2000 blood lead objective, is to direct resources toward increasing the network of states conducting lead surveillance and enhancing the surveillance systems in the states already participating.

## Occupational Hazard Surveillance in New Residential Construction

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Health hazards, residential construction

### Purpose:

To identify potential health hazards associated with different residential construction tasks.

### Abstract:

This pilot project will evaluate the residential home construction process from start to finish. In this project each phase of residential construction will be monitored for potential hazards associated with specific tasks. Phases such as foundation pouring, framing, roofing, wiring, plumbing, drywalling, carpet laying, etc., will be observed and the hazards documented. Hazards that warrant quantification (e.g., noise, dust exposure, solvents, etc.) will be measured using appropriate sampling methods. A single home will be evaluated during each phase of construction. Qualitative and quantitative assessment of exposure related to specific tasks will be performed. An exposure profile for each task will be generated using collected data. A final report documenting the relevant findings will be generated. This data will provide an indication of the magnitude of specific exposures and guide future hazard surveillance efforts in the area of construction. Also, the data will be used to recommend appropriate control technologies to reduce/eliminate exposure. This project will help to fill the informational gaps relating to hazard surveillance in the residential construction industry.

## Prevention Through Health Insurance of Construction Trades Workers

### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Construction trades workers, surveillance, health insurance claims

### Purpose:

To identify elevated illness, condition, or injury relevance among construction trades workers using health insurance claims utilization data as a surveillance tool.

### Abstract:

This study will evaluate the use of health insurance claims utilization data as a surveillance tool. Few other sources of national morbidity data are available for construction workers. One of the primary sources of available data, i.e., the revised annual survey of occupational injury and illness, contains less detailed information for diagnosis and occupation. The annual survey is conducted by the Bureau of Labor Statistics (BLS). Moreover, the survey provides data on primarily the acute illness and injuries that occurred at work or that caused missing days of work. Health insurance utilization data includes data for a broad spectrum of work-related chronic disease, including its cost and treatment. In addition, the denominator used by BLS to estimate the rates of illness and injury

does not reflect the high part-time work that construction workers experience, resulting in lowered rates. This study will use health insurance utilization data linked with union administrative records, to estimate prevalence and incidence rates of work-related illness, injuries, and conditions. The analysis will identify diagnoses with elevated prevalence among construction trades workers and assess the feasibility of using the data to estimate magnitude and cost. If appropriate, the rates will be compared to those from BLS and workers compensation. It is possible that health insurance data that are routinely collected may provide a new source of morbidity surveillance data.

## State Profiles for the Construction Industry

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Occupational illness, injury, state

### Purpose:

To quantify the prevalence and incidence of occupational illness and injury among construction workers in each state.

### Abstract:

State profiles for the construction industry will be developed to assess occupational illness and injury among construction workers in each state. Data sources will include state-level data collected for the Bureau of Labor Statistics (BLS) annual survey of occupational illness and injury, state-level workers' compensation data, death certificate data collected through the National Occupational Mortality Survey (NOMS), and, where available, union data from mortality studies and insurance records. Demographic profiles of construction workers in each state will be compiled using Census and/or state data sources. The profiles will provide information for a broad assessment of mortality and morbidity in a major industry that could provide informational resources to assist in identifying areas responsive to intervention programs and to assist in the definition of the social and economic consequences of workplace illness and injury. The state profiles will be developed to quantify the prevalence and incidence of occupational illness and injury among construction workers in each state using multiple data sources. The state profiles will provide a resource in identifying excess risks, selected targets for intervention, costs of morbidity; differences among states in illnesses and injuries, trends. During 1997 anticipated accomplishments for this program include: (1) survey, assessment, and collection of data from the above-mentioned resources; (2) development of a standardized format to enhance dissemination efforts. Long-term goals include dissemination of state profiles for the Construction Industry; establishment of procedures that will allow periodic updates of these profiles; efficient response to NIOSH, state requests for information; and input in the establishment of priorities within the construction industry by federal/state governments, unions.

## • Disease and Injury

### I. Hearing Loss

#### Hearing Loss Prevention Program for Construction Workers

### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Occupational hearing loss, hearing protectors, hearing loss prevention, health beliefs and behaviors, education and training field studies

### Purpose:

To field test three new intervention components for preventing occupational hearing loss among construction workers in general, and carpenters in specific.

### Abstract:

In this project, results from a NIOSH study to develop hearing conservation programs for underserved workers will be integrated into a single hearing loss prevention program and field tested among apprentice carpenters. Major goals are to provide carpenters with a functional awareness of hazardous occupational noises so, as informed workers, they may make reasoned choices as they practice hearing loss prevention. A hazardous task inventory of carpentry activities will be used to educate carpenters about the hearing hazards associated with their work. This will enable carpenters to know which job tasks and work environments are likely to jeopardize their hearing. Next, the results of laboratory research in health communications will be used to apply new training tools capable of shaping positive behaviors regarding hearing protection use. This involves (1) training materials addressing barriers that carpenters have indicated would prevent them from taking reasonable steps to prevent hearing loss; and (2) a survey tool which can quantify the effectiveness of these training materials. This survey tool will reduce to two years the time needed to assess the effectiveness of this hearing loss prevention program versus the present five to ten years based on audiology alone. Finally, a new information management system that has been developed with non-government partners will employ optical card technologies to enable both workers and management to have better control over and access to occupational safety and health records. The optical card system will allow managers, workers, and health care professionals to have prompt feedback on the presence or absence of significant hearing changes to both individuals and worker populations. This feedback will be a powerful motivating tool either to encourage the continuation of effective hearing health behaviors, or to stimulate changes to an ineffective hearing loss prevention program. This project is expected to increase carpenters' hearing loss prevention behaviors, decrease the incidence of occupational hearing loss among carpenters, and serve as a model for implementing hearing loss prevention programs among construction workers in general.



## II. Musculoskeletal Disorders of the Upper Extremities

### Evaluation of Muscle Strength Capability for Handling Large-Size Materials

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Material handling, muscle strength

**Purpose:**

To evaluate static muscle strength capability of construction workers while handling large-size materials.

**Abstract:**

This is a laboratory-based study to evaluate whole-body static muscle strength capability of construction population while handling large materials. A study protocol has been developed and is under review. Evaluation of lifting tasks using a simulated scaffold end frame will be initiated following approval of the study protocol. Whole-body static muscle strength capability of a construction population study group during manual lifting at different hand locations (three levels of vertical distance from floor and three levels of hand separation) and lifting postures will be collected using a strength measurement system. During static lifting, each exertion will last for five seconds with two minutes of rest between exertions.

### Biomechanical Stress Control in Drywall Installation

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Drywall installer, traumatic injuries, overexertion, exposure assessment, hazard control

**Purpose:**

To identify drywall installer's activities associated with hazards of traumatic injury, overexertion hazards, and assess methods to control these injuries and hazards.

**Abstract:**

This project will identify the drywall installers' activities associated with the hazards of traumatic injuries and overexertion hazards, and assess risk-reduction principles/techniques for controlling such injuries and hazards. The project will examine different approaches to estimating the population of at-risk drywall installers, using source data from the Bureau of Labor Statistics. In addition, two parallel efforts will be performed to identify the high-risk activities associated with the traumatic injuries and overexertion hazards of drywall installation work—analysis of videotaped data, and a drywall-installation survey for identifying high-risk tasks and activities. These two exposure assessments, which will identify workers subject to the greatest biomechanical stresses/hazards/injuries to the back, neck, and upper extremities (shoulder, elbow, and hand), or are perceived as most stressful by the workers, will be selected for ergonomic evaluation. The ergonomic evaluation will

involve laboratory and computer simulations using drywall installers to evaluate work methods. For each work method, compression force on the L5/S1 disc, strength requirements of each body joint, postural stability, and muscle activities (surface electromyography measurements) during activities/tasks will be quantified and compared to known strength-limit values. The stresses that exceed acceptable limits will be identified. Recommendations for an ergonomic redesign of work methods/devices will be developed.

### Ergonomic Evaluation of Carpenter Tasks

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Activities, hazards, fall, overexertion, injuries

**Purpose:**

To identify activities and hazards that put workers at risk of fall and overexertion injuries.

**Abstract:**

The first component of this project was a field study to identify activities and hazards that put workers at risk of fall and overexertion injuries. Several project tasks have already been completed: 12 construction sites (29 subjects) were visited to observe and videotape workers performing handling tasks, video analyses were performed to characterize common techniques and handling strategies, and computer simulations of these common activities were completed to identify safer and less stressful handling methods. Follow-up pilot studies examined parameters that will help to evaluate selected handling techniques in laboratory studies. These parameters include workers' motor response times to expected and unexpected events and postural stability during lifting and carrying activities. Three laboratory studies will be conducted to determine improved carrying and lifting techniques for scaffold end frames.

### Systems Approach To Reduce Manual Task Injuries

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Work-related musculoskeletal disorders, participatory ergonomics

**Purpose:**

To reduce accidents and injuries associated with manual tasks through use of a systems approach to manual tasks and the use of participatory ergonomics processes.

**Abstract:**

Mine workers experience a high incidence and prevalence of Work-Related Musculoskeletal Disorders (WMSDs). Manual tasks are pervasive in mining and are a major contributing factor to disabling strain and sprain injuries. This research project is focused on reducing worker exposure to WMSD risk factors through use of a systems approach to manual tasks and the use of participatory ergonomics processes in mining. The project consists of two major

initiatives directed at reduction of work-related musculoskeletal disorders (WMSDs) in the mining industry. One of the primary focuses is to conduct an analysis of jobs involving manual tasks and their associated hazards at mines representing a range of mining methods. The other primary thrust of this project is to evaluate the effectiveness of the participatory ergonomics approach in the mining industry. The results of this work will help to reduce accidents and injuries associated with manual tasks in mining and other related industries.

## • Other Research Topics

### I. Education and Training

#### Lead-Based Paint Abatement Training Grants

##### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Lead-based paint, training, health and safety issues

##### Purpose:

To train individuals who conduct lead-based paint abatement activities on health and safety issues.

##### Abstract:

Title X of the Housing and Community Development Act of 1992 requires that all individuals who conduct lead-based paint activities (risk assessment, inspection, supervision, and abatement) must meet minimum training requirements and receive certification from an EPA-approved program. Approximately 62% of privately owned dwellings constructed between 1960-1979, 80% between 1940-1959, and 90% constructed before 1940 have lead-based paint.

NIOSH has awarded grants to the UBC Health and Safety Fund of North America and the Laborers-AGC Education and Training Fund to ensure that lead-based paint abatement workers and supervisors receive adequate training and education on the health and safety issues related to lead-based paint abatement. The awardees must use EPA- and HUD-approved training materials to develop a four-year training program for workers and supervisors involved in abatement.

#### NIOSH Hazardous Substance Training Program

##### For more information contact:

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Hazardous substance, training, workers, Educational Resource Centers

##### Purpose:

To conduct a program in hazardous substance training for government personnel and others involved in the management of hazardous substances.

##### Abstract:

In 1988, NIOSH entered into an Interagency Agreement with the National Institute for Environmental Health Sciences to conduct a continuing education program in hazardous substance training for state and local health and environmental agency personnel and other professionals engaged in the management of hazardous substances. The two components of this program are the Hazardous Substance Continuing Education Program (HST) and the Hazardous Substance Academic Training Program (HSAT).

Since 1988, 540 courses have been offered to 1,764 students in the Hazardous Substance Continuing Education Program. HST is a component of the continuing education program within NIOSH Educational Resource Centers and includes the following elements: (1) the coordination of training with agencies responsible for cleanup, enforcement, and training of personnel under CERCLA/SARA and other relevant groups; (2) a plan to develop and implement a program of instruction over the proposed project period; (3) a Project Director with demonstrated capacity for providing leadership in hazardous substance activities; (4) project staff; (5) the implementation of short courses and continuing education programs for federal, state and local health environmental professionals and others involved in handling hazardous substance; and (6) evaluation of the program.

The purpose of the Hazardous Substance Academic Training Program is to initiate a series of academic courses to prepare occupational safety and health professionals for practice, research, and teaching with a specialization in hazardous substances. The ultimate objective of this program is to incorporate hazardous substance training into the academic curriculum. The program components include: (1) a needs assessment; (2) a training plan; (3) a formalized curriculum that includes minimum course work toward a degree, training objectives, course description, course content and didactic and field experience; (4) a competent and experienced program director and staff; and (5) evaluation of the program. This is a speciality program in the existing Educational Resource Center (ERC) Industrial Hygiene core program. Approximately 40 students are being supported in this program.

Grantees for this program include:

Alabama Educational Resource Center  
University of Alabama at Birmingham  
School of Public Health  
Birmingham, AL  
Center Director: Vernon Rose, Dr.P.H.  
HST Director: Elizabeth Maples, M.P.H.  
HSAT Director: R. Kent Oestenstad, Ph.D.

Northern California Educational Resource Center  
University of California, Berkeley  
School of Public Health  
Berkeley, CA 94720  
Center Director: Robert Spear, Ph.D.  
HST Director: Barbara Plog, M. P.H.

Southern California Education Resource Center  
University of Southern California  
School of Medicine  
1540 Alcazar St., Suite 236  
Los Angeles, CA 90033  
Center Director: John Peters, M.D.  
HSAT Director: William Hinds, Sc.D.

Cincinnati Educational Resource Center  
University of Cincinnati  
Department of Environmental Health  
3223 Eden Avenue  
P.O. Box 670056  
Cincinnati, OH 45267-0056  
Center Director: C. Scott Clark, Ph.D.  
HSAT Director: C. Scott Clark, Ph.D.

Harvard Educational Resource Center  
Harvard School of Public Health  
665 Huntington Avenue  
Boston, MA 02115  
Center Director: David Christiani, M.D.  
HST Director: Daryl Bichel  
HSAT Director: Stephen N. Rudnick, Sc.D.

Illinois Educational Resource Center  
University of Illinois at Chicago  
School of Public Health  
2121 W. Taylor St.  
Chicago, IL 60612-7260  
Center Director: Dan Hryhorczuk, M.D., M.P.H.  
HST Director: Helen Elkiss, M.P.H.  
HSAT Director: Richard Wadden, Ph.D.

Michigan Educational Resource Center  
University of Michigan  
College of Engineering  
1205 Beal Ave.  
Ann Arbor, MI 48109  
Center Director: W. Monroe Keyserling, Ph.D.  
HSAT Director: Stuart Batterman, Ph.D.

Minnesota Educational Resource Center  
University of Minnesota  
School of Public Health  
420 Delaware Street  
Minneapolis, MN 55455  
Center Director: Ian Greaves, M.D.  
HST Director: Jeanne Ayers, M.P.H., R.N.  
HSAT Director: Lisa Brosseau, Sc.D.

New York/New Jersey Educational Resource Center  
Mt. Sinai School of Medicine  
1 Gustave L. Levy Place  
P.O. Box 1057  
10 E. 102nd Street  
New York, NY 10029-6574  
Center Director: Philip Landrigan, M.D.  
HST Director: Audrey Gotsch, Dr.P.H.  
HSAT Director: David Kotelchuck, Ph.D.

North Carolina Educational Resource Center  
University of North Carolina  
School of Public Health  
Rosenau Hall, CB#7400  
Chapel Hill, NC  
Center Director: Michael Flynn, Ph.D.  
HST Director: Larry Hyde, M.S.

Utah Educational Resource Center  
University of Utah  
School of Medicine- Bldg. 112  
Salt Lake City, UT 84112  
Center Director: Royce Moser, Jr. M.D., MPH  
HST Director: Connie Crandall, MBA  
HSAT Director: Dean Lillquist, Ph.D.

Washington Educational Resource Center  
School of Public Health and Community Medicine  
Seattle, WA 98195-7234  
Center Director: Gerald van Belle, Ph.D.  
HST Director: Sharon Morris  
HSAT Director: Michael Morgan, Sc.D.

## II. Human Factors

### Influence of Visual Cues and Restricted Space on Work at Elevation

#### For more information contact:

The National Institute for Occupational  
Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Visual cues, height, restricted space,  
workers' performance

#### Purpose:

To study the effects of visual cues on height and restricted space on workers' performance.

#### Abstract:

This project will study the effects of visual cues of height and restricted space on workers' performance. This study will be conducted using a virtual workplace created by a mini-super computer and virtual reality software. The subjects will be immersed in a virtual workplace in which they are standing on an elevated scaffolding board. The height and width of the scaffolding board will be changed in software for the different performance tests. The width ranges will be examined at various heights, various speeds, and various tasks. The data from this project will be used to determine the minimum and optimal width requirements of platforms and planks for construction workers to safely perform their tasks at various heights. Partners of this research may include iron worker associations, the Scaffold Industry Association, the American Society for Testing Materials (ASTM) and the Society of Automotive Engineers (SAE).

### III. Other Research Topics

#### Worker Safety for Independent Contractors

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Independent contractors, mining, contributing factors, loss prevention

**Purpose:**

To reduce injuries to independent contractor employees who work on mine property.

**Abstract:**

The number of fatalities to independent contractor employees working in the mining industry continues to be disproportionate to those of mine company employees. Further, their fatality incidence rates have been significantly higher than operator rates in 12 out of the past 13 years. Between 1990 and 1995, a total of 122 independent contractor fatalities occurred in the U.S. mining industry. In a large percentage of these injuries, the victim was involved in construction-type work activities. This study is investigating the applicability and methodology for introducing effective loss prevention techniques, established in general industry, into the mining industry. Prominent contributing factors responsible for these injuries will be identified, and appropriate interventions will be developed. The latter will include safe construction practices as well as best practices models. The results of this investigation will improve the safe job performance of a large number of independent contractor workers who work on mine property. Moreover, because many of these companies are also employed outside the mining industry, the results will benefit certain general industry construction workers, as well.

#### Evaluation of Substitute Materials Used in Construction

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Abrasive blasting, silica, substitute materials, asbestos substitutes

**Purpose:**

To study the *in vitro* and *in vivo* toxicity of several abrasive substitutes and determine the role of length versus chemistry in the fibrotic potential of asbestos substitutes.

**Abstract:**

Silica and asbestos are known to cause lung damage and fibrosis. Therefore, efforts are being made to develop abrasive substitutes for silica in sandblasting and to introduce man-made fibers to replace asbestos in construction materials. It is essential that the pathogenic potential of substitutes be evaluated to prevent future occupational lung disease. This project will evaluate the toxicity of these particles using assays of lung cell function and viability after both *in vitro* and *in vivo* exposure to these materials.

#### Mortality Study of Painters

**For more information contact:**

The National Institute for Occupational Safety and Health  
1-800-35-NIOSH (356-4674)

**Keywords:** Painters, mortality study, cancer

**Purpose:**

To determine which cancers are definitively linked to painting, and what agents in paint are responsible.

**Abstract:**

The U.S. cohort of 57,000 members of the Painters and Allied Trades, 34,000 of whom are painters, is the largest cohort of painters in the world. Original follow-up of this cohort extended only through 1979 and included 5,000 deaths. Follow-up of this cohort will be extended an additional 15 years through 1994, which will increase the number of deaths to approximately 23,000. This will vastly increase the power of the cohort study to detect excess risks. Approximately 1,400 lung cancer deaths, 215 stomach cancer deaths, 170 bladder cancer deaths, and 170 hematopoietic cancer deaths are expected. In addition, new information will be obtained from the Painters Union regarding the length of union membership for approximately one third of all cohort members. This information was not available in the original study. Duration of membership will provide data enabling investigators to test for a trend of increased cancer with increased duration of employment as a painter. Death information will also be collected on multiple cause mortality (all causes of death on the death certificate) for the majority of the cohort, enabling analysis of disease that might not be the underlying cause of death (eg., renal disease and neurologic disease due to solvents). In 1997, this project will obtain all causes of death for all decedents, conduct mortality analyses, and complete a draft report. Long-term accomplishments include completing a final report, determining whether nested case-control studies are warranted for specific cancers to identify the agents responsible for excesses.

**For Information on Other  
Occupational Safety  
and Health Concerns**

Call NIOSH at:  
1-800-35-NIOSH (356-4674)

or visit the NIOSH Homepage at:  
<http://www.cdc.gov/niosh/homepage.html>

