NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2003-0351-2972
Freudenberg-NOK
High Quality Plastics Division
Findlay, Ohio

June 2005

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Gregory Burr, Daniel Habes, and Richard Driscoll of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). The industrial hygiene field investigation was conducted by Ann Krake of HETAB. Analytical support was provided by Data Chem. Desktop publishing was performed by Robin Smith, and editorial assistance was provided by Ellen Galloway.

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Highlights of the NIOSH Health Hazard Evaluation (HHE)

Evaluation of Ring Seals

In August 2003 the National Institute for Occupational Safety and Health (NIOSH) received a confidential HHE request from employees at Freudenberg-NOK G.P., High Quality Plastics Division (HQP) Findlay, Ohio. They were concerned about potential exposure to airborne particles and fumes from the manufacturing of thermoplastic and polytetrafluroethylene (PTFE) ring seals. Some workers were experiencing non-specific respiratory symptoms and itchy skin.

What NIOSH Did

- We took air samples for chemicals that may be present in Teflon® fumes.
- We took samples for glass fibers, metals, and respirable dust.
- We spoke to workers who asked to be interviewed about their health concerns and their work area.
- We looked at employee injury and illness records.
- We observed work practices for ergonomic problems.

What NIOSH Found

- We did not find any overexposures to chemicals that may be present in Teflon fumes.
- We measured very low levels of metals and respirable dust.
- Most workers we spoke with did not have symptoms they associated with working conditions at HQP.
- Some interviewed workers complained of dry itchy skin they associated with exposure to fibrous glass in the plastic mix.
- Some workers reported muscle fatigue in the arms and low back from lifting heavy loads into the ovens.
- We saw some physically demanding work that may be improved by redesigning parts containers and handles.

What High Quality Plastics Managers Can Do

- Redesign the mandrel containers so a full one weighs less than 25 pounds.
- Redesign the handle on the mandrel containers. We suggest slightly oval-shaped handles about 2 inches in diameter and 4 to 6 inches in length.
- Provide more vacuums to clean machinery and discourage the use of compressed air.
- Check how well the existing vacuums capture dust, and replace with better vacuums or higher efficiency air filters if necessary.

What the High Quality Plastics Employees Can Do

- Do not use compressed air to clean machinery. Instead, use a vacuum.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2003-0351-2972

Health Hazard Evaluation Report 2003-0351-2972
Freudenberg-NOK
High Quality Plastics Division, Findlay, Ohio
June 2005

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SUMMARY

In August 2003 the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation (HHE) from employees at Freudenberg-NOK G.P., High Quality Plastics Division (HQP) in Findlay, Ohio. Employees were concerned with potential exposure to airborne particles and fumes created during the manufacture of polytetrafluroethylene (PTFE, Teflon®) and thermoplastic rotating ring seals. The initial request noted that workers were experiencing non-specific respiratory symptoms, itchy skin, and "oven fever" (presumably from exposure to PTFE fumes generated during the manufacturing process). In subsequent conversations with the requesters concerns involving heavy lifting and repetitive movement were also mentioned.

Personal breathing zone (PBZ) and general area (GA) sampling was performed for hydrogen fluoride, carbonyl fluoride, glass fibers, elements (cobalt, zirconium, tin, and chromium), and respirable particulate. PBZ and GA air samples were collected from Work Cells 1, 3, 3N, 5, 6, 7, 8, and 10. Workers who requested to speak with NIOSH representatives were interviewed to determine the extent and severity of their health concerns. We also reviewed Occupational Safety and Health (OSHA) Illness and Injury logs for the years 1999-2003. The ergonomics evaluation consisted of a walk through of the plant to view the variety of job tasks workers perform to produce PTFE and thermoplastic seals, subassembly systems, and plastic mating components.

No overexposures to fibrous glass, gaseous and particulate fluorides, respirable dust, or metals were found, based on PBZ and GA air samples collected on the days of this evaluation. Most interviewed workers did not have symptoms they attributed to working conditions at HQP. However, some interviewed workers complained of dry, itchy skin that they associated with exposure to fibrous glass in the plastic mix, and three workers reported muscle fatigue in the arms and low back from lifting heavy loads into the ovens. We observed some physically demanding work that may be improved by redesigning parts containers and handles.

NIOSH investigators conclude that a health hazard does not exist at this facility. However, some work is physically demanding and improvements can be made to the containers used to handle the mandrels. Recommendations have been provided to redesign a container used to transport mandrels around the plant.

Keywords: SIC 3053/NAICS 339991 (Gaskets, Packing, and Sealing Devices, Manufacturing), Teflon®, PTFE, polymer fume fever, glass fiber, hydrogen fluoride, carbonyl fluoride, cobalt, zirconium, tin, chromium, respirable particulate, ergonomics.

Table of Contents

INTRODUCTION

On August 21, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation (HHE) from employees at Freudenberg-NOK G.P., High Quality Plastics Division (HQP) in Findlay, Ohio. Employees were concerned with potential exposures to airborne particles and fumes created during the manufacture of polytetrafluroethylene (PTFE, Teflon®) and thermoplastic rotating ring seals. The request noted that workers were experiencing non-specific respiratory symptoms, itchy skin, and "oven fever" (presumably from exposure to PTFE fumes generated during the manufacturing process). In subsequent phone conversations with the employee requesters, ergonomic concerns involving heavy lifting and repetitive movement were also mentioned.

During December 17 – 18, 2003, we conducted a site visit at HQP. Our evaluation team included an ergonomics specialist, an epidemiologist, and an industrial hygienist. Following an opening conference, we conducted a plant walk-through, interviewed 22 workers, and observed the work tasks specified in the HHE request. A closing conference was held on December 18, 2003.

Based on information gathered during our initial site visit, a follow-up evaluation was conducted during August 24 – 26, 2004. Personal breathing zone (PBZ) and general area (GA) air samples were collected for a variety of compounds associated with the manufacture of PTFE products. Sampled substances included gaseous and particulate hydrogen fluoride (and fluorides), glass fibers, metals (cobalt, zirconium, tin, and chromium), respirable silica, and natural graphite.

BACKGROUND

Facility Description

In operation since 1978, HQP designs and manufactures PTFE and thermoplastic rotating seals, subassembly systems, and plastic mating components. Over 250,000,000 parts are produced annually for automotive and industrial customers. The parts are used in a wide spectrum of applications, including automatic transmissions, power steering units, air-conditioning and industrial compressors, hydraulic and pneumatic cylinders, and petrochemical valves.

At the time of the two NIOSH site visits approximately 110 people worked at HQP over three shifts. A mixture of PTFE powder, fiberglass, natural graphite, and various metals is blended and then manually scooped into a hopper. At the time of this evaluation workers performing this operation did not routinely wear gloves. From the hopper the mixture is fed into sleeve molds, compressed, baked in an oven at approximately 700°F, and then sliced into individual rings. After being tumbled clean, these sliced rings receive a final inspection before shipping.

METHODS

Industrial Hygiene

PBZ and GA air sampling was performed for gaseous and particulate fluoride compounds, glass fibers, respirable particulate, and elements (specifically the metals cobalt, zirconium, tin, and chromium, which were listed in the Material Safety Data Sheets as some of the raw materials used to produce the rotating seals, subassembly systems, and plastic mating components). These substances have been identified in the scientific literature as potential exposures during the manufacture of PTFE products. Air sampling was conducted in Work Cells 1, 3, 5, 6, 7, 8, and 10. Table 1 summarizes the sampling and analytical methods used.

Epidemiology

Following the plant walk-through on August 24, 2003, we interviewed 22 workers to determine the extent and severity of their health concerns. We spoke with all those who requested an interview with NIOSH representatives; therefore, these results do not necessarily

represent the experiences and health concerns of the full workforce. In addition to confidential interviews, Occupational Safety and Health Administration (OSHA) Form 200/300 Illness and Injury logs were reviewed for the years 1999-2003.

Ergonomics

The ergonomics evaluation consisted of a walk-through survey of the plant to observe the variety of job tasks workers perform to produce PTFE and thermoplastic seals, subassembly systems, and plastic mating components. Activities were selected because they involved high repetition, awkward postures, high muscular effort, and manual lifting; risk factors for work-related musculoskeletal disorders (WMSDs); or because they were specified as problematic at the opening conference.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).[3] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

PTFE (Teflon®)

In its pure form, PTFE is white to translucent, nonflammable, and generally unaffected by most organic solvents and acids. In fact, no substance has been found in which this polymer will dissolve.[4] These chemical characteristics make PTFE ideal as a low friction coating (on cooking utensils and reaction vessels) and in other industrial applications to prevent adhesions.

There is no OSHA PEL or NIOSH REL for PTFE.

PTFE Decomposition Products

PTFE begins decomposing when heated above approximately 440º C, and this chemical breakdown continues until about 590º C. At lower temperatures the principal toxic component may be particulate containing oxygen difluoride, ionized carbonyl, and tetrafluoromethane. At higher temperatures, perfluoroisobutylene (a highly toxic gas) may be formed.[4] In this evaluation samples were collected for gaseous and particulate fluorides, and thermal desorption tubes were analyzed using a gas chromatograph with a mass selective detector to scan for a wide variety compounds, including perfluoroisobutylene. See Table 1 for more details on sampling and analytical methods.

Polymer Fume Fever

Polymer fume fever is a recognized condition characterized by chills, fever, chest tightness, and other flu-like symptoms, but to date no reports of human fatalities have been documented.[4] There are several types of PTFE that react differently to varying temperature and humidity conditions. Therefore there is no practical way to express a single safe concentration that applies to the variety of PTFE products and the complex mixture of chemicals that may be present during PTFE decomposition.

Ergonomics

Overexertion injuries and musculoskeletal disorders such as low back pain, tendinitis, and carpal tunnel syndrome are often associated with job tasks that include: (1) repetitive, stereotyped movement about the joints; (2) forceful manual exertions; (3) lifting; (4) awkward and/or static work postures; (5) direct pressure on nerves and soft tissues; (6) work in cold environments; or (7) exposure to whole-body or segmental vibration.[5,6,7,8] The risk of injury appears to increase as the intensity and duration of exposures to these factors increase and the recovery time is reduced.[9] Although personal factors (e.g., age, gender, weight, fitness) may affect an individual's susceptibility to overexertion injuries/disorders, certain studies conducted in high-risk industries suggest that the risk associated with personal factors is small compared to that associated with occupational exposures.[10]

In all cases, the preferred method for preventing and controlling WMSDs is to design jobs, work stations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the worker. Under these conditions, exposures to task factors considered potentially hazardous are reduced or eliminated.

RESULTS AND DISCUSSION

Industrial Hygiene

- No gaseous or particulate fluoride was detected in any of the PBZ air samples collected from operators in Cells 3, 5, 6, 7, and 8. Similar results were obtained for GA air samples near Ovens 2 and 16. The minimum detectable concentrations (MDCs) for gaseous and particulate fluoride in this sample set were 1.3 micrograms per cubic meter ($\mu g/m^3$) and 6.3 $\mu g/m^3$, respectively.
- Of the 29 metals and minerals analyzed in PBZ and GA air samples collected from Cells 1, 7, and 10, 28, only calcium (a mineral commonly present in occupational and non-occupational environments) was measured above trace concentrations.
- No respirable dust was measured in the PBZ samples collected from operators in Cells 1, 3N, 5, 9, and 10. The MDC for this sample set was 0.03 milligrams per cubic meter (mg/m^3).
- Airborne fiberglass concentrations from both PBZ and GA air samples collected at Cells 3N, 7, 9, and 10 ranged from 1.9 to 3.9 fibers per cubic centimeter (f/cc). The average length of these fibers was approximately 100 micrometers (µm) and their average diameter was 20 µm. The NIOSH REL of 3 f/cc is intended for small glass fibers that have a

diameter of less than or equal to 3.5 µm; however, all of the fiber diameters in this sample set were much larger, averaging close to 20 µm. Therefore, the most applicable NIOSH REL is for total fibrous glass dust of 5 mg/m^3, TWA for up to a 10-hour work day. Based on the work activities we observed during this evaluation and the dust levels generated, it seems unlikely that employees would exceed the NIOSH REL for fibrous glass dust of 5 mg/m^3, TWA over the course of an 8-hour work day.

- Morphological examination of graphite dust bulk samples from Cells 2 and 8 revealed smooth sided glass fibers approximately 15 µm in diameter. The lengths of the fibers (which could have been altered mechanically during sample preparation) ranged from less than 20 µm to well over 200 µm.
- Qualitative GA air samples for volatile organic compounds collected near Cells 2 and 10 identified a variety of compounds, including toluene, hexachloroethane, propane, isobutene, limonene, and various aliphatic hydrocarbons and alkyl benzenes. No fluorohydrocarbons, which would be representative of polymer fumes, were detected. Perfluoroisobutylene, a toxic by product that may be created during the thermal degradation of polytetrafluoroethylene, was also not detected.

Epidemiology

Most workers interviewed had no symptoms that they attributed to working conditions at HQP. Four complained of dry itchy skin and associated this with exposure to fibrous glass in the plastic mix. Three workers, who also reported they had been diagnosed with asthma, were concerned about dust levels in the work environment. In addition, three others reported muscle fatigue in the arms and low back from lifting heavy loads into the ovens.

We reviewed OSHA 200/300 Injury and Illness logs for trends of recordable health problems or work areas where problems may have clustered. Laceration injuries were most commonly reported and ranged from a high of 46% (17 lacerations) of all injuries reported in 1999 to 20% (1 laceration out of 5 injuries reported) in 2003. Nearly all of the lacerations occurred among slicer operators. In addition to lacerations, low back strain was routinely reported among press operators who lifted heavy and or large loads.

Ergonomics

We observed some work activities that involved lifting, carrying, and pulling. In Cell 2 at the rear of the plant nine ovens contained mandrels that had to be lifted out by hand. The ovens were old and rusty, making it difficult to slide out the trays that contained the mandrels. This operation was not running at the time of the NIOSH site visit and it was not clear how often this work was performed.

A physically demanding work activity performed at most of the cells was collecting used mandrels from the molding machines. After performing the seal making operation, the machines dropped the mandrels into a white plastic bucket. At the time of our evaluation a line on the bucket indicated how full it should get before a worker needed to slide it out from under a machine and replace it with an empty container. With the arrangement of machines in the cell areas the workers operating the molding machines often could not see the plastic bucket. The buckets then overfilled and workers reported that they waited until they could hear the mandrels dropping on the floor before retrieving the buckets. The weight of the full bucket varied, depending on the size of the mandrel, but full containers could weigh up to 50 pounds.

After our initial site visit in December 2003, a plant production manager contacted NIOSH investigators to request design information and handle configuration for new mandrel containers. We recommended designing the containers so they would weigh no more than 25 pounds when filled, equipping them with round or slightly elliptically-shaped handles. We suggested that the handles measure approximately 1.25 to 2 inches in diameter, and 4 to 6 inches in length.[11]

CONCLUSIONS

- We documented no overexposures to fiberglass, respirable dust, or metals, based on PBZ and GA air samples collected on the days of this evaluation.
- No PTFE decomposition products, represented by gaseous and particulate fluorides and perfluoroisobutylene, were found. This suggests that workers were not being exposed to polymer fume.
- We observed some physically demanding work that could be improved by redesigning parts containers and handles.
- Some workers reported muscle fatigue in the arms and low back from lifting heavy loads into the ovens.
- Most interviewed workers did not have symptoms they attributed to working conditions at HQP.
- Some interviewed workers reported dry itchy skin they associated with exposure to fibrous glass in the plastic mix, and several workers had been diagnosed with asthma.
- We observed employees using compressed air to clean dust off the press machines, a practice that generated dust in the work area. Shop vacuums were also used to clean up scrap from the work areas. However, workers said the filters used on these shop vacuums did not effectively capture the dust.

RECOMMENDATIONS

1. Redesign the mandrel containers so that a full container weighs no more than 25 pounds.
2. Redesign the handle on the mandrel containers. We suggest equipping these containers with a round or slightly elliptically-shaped handle, approximately 1.25 to 2 inches in diameter, and 4 to 6 inches in length.
3. Use vacuuming instead of compressed air to clean machinery to further lower dust levels.
4. Evaluate the shop vacuums in use during this survey and replace the vacuums and/or air filters, if needed, to improve the dust capturing ability of this equipment.

REFERENCE

1. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

2. ACGIH [2004]. 2004 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. CFR [2003]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

4. ACGIH [2003]. Documentation of the TLVs® and BEIs®, with other worldwide occupational exposure values. American Conference of Governmental Industrial Hygienists Cincinnati, OH:

5. Armstrong TA, Radwin RG, Hansen DJ [1986]. Repetitive trauma disorders: job evaluation and design. Human Factors 28(3): 325-336.

6. Gerr F, Letz R, Landrigan P [1991]. Upper-extremity musculoskeletal disorders of occupational origin. Annu Rev Publ Health 12:543-66.

7. Rempel D, Harrison R, Barnhart S [1992]. Work-related cumulative trauma disorders of the upper extremity. JAMA 267(6):838-842.

8. NIOSH [1997]. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational

Safety and Health, (DHHS) Publication No. 97-141.

9. Moore JS and Garg A [1995]. The strain index: a proposed method to analyze jobs for risk of distal upper extremity disorders. Am Ind Hyg Assoc J 56:443-458.

10. Armstrong TJ, Buckle P, Fine LJ, et al. [1993]. A conceptual model for work-related neck and upper-limb musculoskeletal disorders. Scand J Work Environ Health 19:73-84.

11. Easy Ergonomics: A Guide to Selecting Non-Powered Hand Tools. California Department of Industrial Relations and the National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication 2004-164, 2004.

TABLE 1

Sampling and Analytical Methods
Freudenberg-NOK High Quality Plastics Division, Findlay, Ohio
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Substance	Sample Media	Analytical Method	Comments
Elements†	37 mm diameter polyvinyl chloride filters, 0.8 micron pore size	NIOSH Method 7303, inductively coupled plasma (ICP) atomic emission spectrometry (AES).	29 different metals and minerals were analyzed (listed at the bottom of this table). Calcium was the only element detected above trace concentrations.
Respirable particulate	Tared 37 mm diameter polyvinyl chloride filters, 0.8 micron pore size	NIOSH Method 0600, gravimetric analysis.	The filters and backup pads were stored in an environmentally controlled room for at least 2 hours for stabilization prior to tare and gross weighing.
Gaseous and particulate fluoride	37 mm diameter mixed cellulose ester filter, 0.8 micron pore size with Na_2CO_3 treated pads	NIOSH Method 7902, ion specific electrode.	Used an Orion 720 A+ meter to analyze these samples.
Volatile organic compounds and PTFE polymer fume	Thermal desorption (TD) tubes	Tekmar thermal desorber interlaced directly to a gas chromatograph and a mass spectrometry detector.	Stainless steel TD tubes containing three beds of sorbent material (Carbopack Y, Carbopack B, and Carboxen 1003.)
Fiber morphology	Bulk sample	NIOSH Method 9002, polarized light microscopy (PLM).	This method was modified to analyze for glass fibers as opposed to asbestos fibers.
Fiberglass	25 mm polycarbonate membrane filter, 1.0 micron pore size	NIOSH Method 7404, scanning electron microscopy.	This NIOSH method was slightly modified to analyze for glass fibers as opposed to cellulose fibers.

mm = millimeter
Na_2CO_3 = sodium carbonate
† = Elements which were analyzed using NIOSH Sampling and Analytical Method 7303: Aluminum, Arsenic, Beryllium, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Lithium, Magnesium, Manganese, Molybdenum, Nickel,, Lead, Phosphorus, Platinum, Selenium, Silver, Sodium, Tellurium, Thallium, Titanium, Vanadium, Yttrium, Zinc, Zirconium, Antimony, Tin

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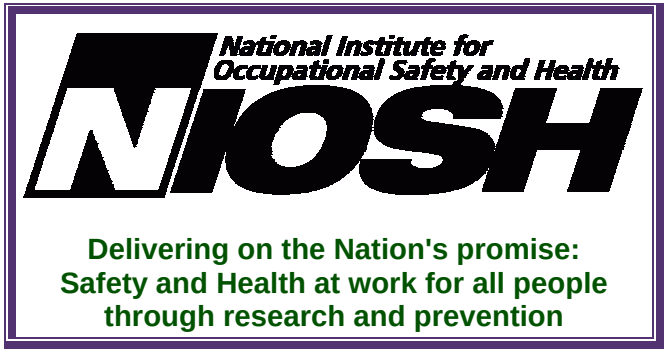

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