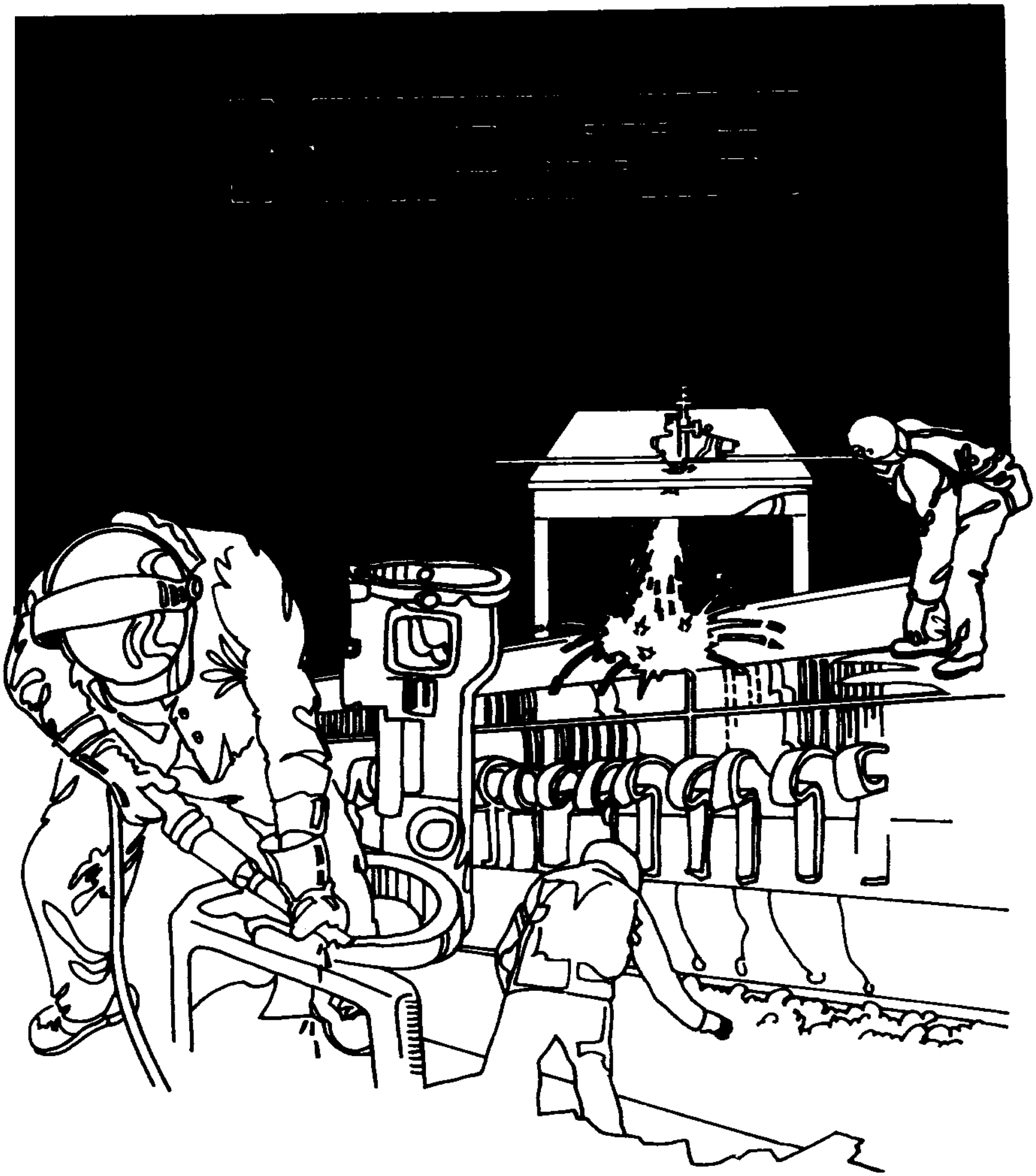

Health Hazard Evaluation Report

HETA 86-231-1954
READE MANUFACTURING COMPANY
LAKEHURST, NEW JERSEY

PREFACE

The Hazard Evaluations and Technical Assistance Branch of 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 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 employer 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) 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.

HETA 86-231-1954
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READE MANUFACTURING COMPANY
LAKEHURST, NEW JERSEY

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I. SUMMARY

In March 1986 the National Institute for Occupational Safety and Health (NIOSH) received a request from employees of Reade Manufacturing Company, Lakehurst, New Jersey, to evaluate exposures to magnesium and aluminum dusts relating to their use in the manufacture of magnesium chips, granules, and powders, and magnesium-aluminum alloy powders.

An initial site visit encompassing a walk through and safety inspection was conducted on December 10 and 11, 1986. A followup industrial hygiene and medical evaluation was conducted jointly by investigators from NIOSH and the New Jersey Department of Health on May 18-21, 1987.

The safety evaluation focused on both fire/explosion and general safety hazards. The environmental evaluation consisted of the collection of personal and general area air samples for magnesium and aluminum dust. Bulk samples of fluorospar (used in the manufacturing process) and talc (used as a fire suppressant) were collected and analyzed for metals, asbestos, and crystalline silica.

The medical evaluation consisted of a questionnaire, determination of blood magnesium concentrations, physical examination, pulmonary function tests, and a review of chest X rays. The evaluation was designed to elicit acute and chronic effects of magnesium dust exposure on the skin and respiratory system.

The safety evaluation revealed no serious or immediate safety hazards at the time of the survey. Environmental sampling revealed magnesium dust concentrations ranging from 0.01 to 17.2 mg/m^3 (average: 0.41 mg/m^3) in the personal breathing-zone samples; five percent (2 of 42) were above 10 mg/m^3. No evaluation criteria exist specifically for magnesium dust, although the American Conference of Governmental Industrial Hygienists (ACGIH) does have a Threshold Limit Value (TLV) of 10 mg/m^3 for magnesium oxide fume, which is equivalent to the TLV for nuisance dust. The OSHA standard for nuisance dust is 15 mg/m^3. Aluminum dust exposures ranged from non-detectable (ND) to 1.6 mg/m^3; fifty percent (21 of 42) were ND (less than 0.01 mg/sample). All samples were below the ACGIH TLV of 10 mg/m^3. Analysis of the fluospar and talc bulk samples revealed the presence of magnesium and aluminum as the primary metals, with trace amounts of other metals. No asbestos or crystalline silica was detected in either bulk sample.

Thirty-seven of 66 production and maintenance workers participated in at least part of the medical evaluation. The medical questionnaire survey results indicated that at least half of the examined workers had experienced nasal symptoms with about one fifth of the workers reporting skin rash. These findings may suggest that magnesium dust acts as an irritant to exposed tissues. All blood magnesium levels were within normal limits. A few workers had abnormal findings on physical examination, but no consistent pattern was identified. Some abnormality was noted on the pulmonary function test results of six individuals. None of the four individuals with an obstructive pattern had a significant increase in obstruction over the course of the workday. The two individuals with minimally restrictive pattern would require additional evaluation for definitive diagnosis of restrictive disease. Neither individual had a history of smoking or exposure to fibrogenic dust. Review of 34 chest X rays showed three workers had pleural thickening.

On the basis of these data, NIOSH investigators did not identify any safety hazards or chemical exposures representing a health hazard to Reade Manufacturing Company employees. Recommendations relating to engineering controls and personal protective equipment are made in Section VIII of this report.

KEYWORDS: SIC 1061 (Ferroalloy Ores, except Vanadium), magnesium, aluminum, dust, talc, fluorospar, irritation

II. INTRODUCTION

On March 4, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from employees of Reade Manufacturing Company in Lakehurst, New Jersey, to conduct a health hazard evaluation (HHE) of their workplace. The HHE was originally assigned to the State of New Jersey Department of Health (NJDOH). Concerns raised by Reade Manufacturing regarding the conduct of the HHE by the NJDOH, the handling of proprietary information, and issues pertaining to the validity and legality of the request, necessitated re-assignment of the project September 11, 1986, to a NIOSH project officer. The NJDOH retained responsibility for conducting the medical portion of the study. The HHE request concerned exposures to materials used as part of, or in the course of, manufacturing magnesium chips, granules, and powders, and magnesium-aluminum alloy powders.

An initial site visit conducted by NIOSH investigators December 10 and 11, 1986. This survey involved an industrial hygiene walk-through by a NIOSH industrial hygienist and a safety inspection conducted by a NIOSH fire safety specialist. A follow-up industrial hygiene survey and medical study was conducted May 18-21, 1987.

Post-survey letters summarizing the activities of each site visit were sent to management and labor representatives January 7, 1987, and June 9, 1987, and the environmental sampling results were reported by letter July 31, 1987. Individual test results notification letters were sent by the NJDOH physician to medical study participants in mid September, 1987. A cover letter along with a copy of the sample (blank) notification form letter was sent to management and labor representatives September 15, 1987.

III. BACKGROUND

A. Plant History and Products:

Reade Manufacturing Company (RMC), a Division of REMACOR, has occupied its current production location since 1941. The plant occupies approximately 10 acres, and the actual process operations are housed in a number of separate single- and two- story buildings that have been added over the years as the process has been changed or enlarged. RMC is a producer of magnesium chips, granules, and powders. The company also manufactures a line of magnesium/aluminum alloy powders. RMC products include a coarse granular powder for metallurigical and chemical reactions, finer powders for pyrotechnics and industrial reactions, and extra fine granular powder (minus 325 mesh, having an average sieve opening of 43 micrometers) for special applications. RMC also manufactures coarse, ellipsoidal, and semi-spherical granules for nodularization of iron. Chips are used for Grignard reagents.

B. Process and Workstation Description

RMC is engaged primarily in a process which mechanically transforms magnesium ingots, pellets, and scrap into granular or powdered forms to meet customer specifications. Essentially, they are a custom grinding operation for magnesium powders. Purity of their product is from 99.7% to 99.98% magnesium. Very little is added to the product, except for instances where the customer may specify a lower magnesium content.

The process generally starts with a grinding slab of magnesium (at least 99.8% pure magnesium). This slab or ingot is sent through a chipping unit (chipper), which reduces the material to chips. To bring the material to the desired particle size range, the chips may now be processed by one or more hammer mills which, with the collection equipment, comprises a grinding unit. Powdered material is collected and drummed after each step of the process. Only material currently being used on the equipment is allowed to be open to the work environment. The material is subsequently screened to assure more uniform particle size distribution of the powders coming from the grinding units prior to shipment to the customer or before any blending operations are performed. Reclaim material can be processed in much the same fashion, although it is not necessarily sent through the chipper prior to being processed by a crusher or a hammer mill. The route that the magnesium will follow through the process again depends upon customer specifications and application.

Worker activity around operating equipment is limited to feeding material into the equipment, filling hoppers, and removing filled drums. Processes handling the finer materials include greater restrictions on worker activity around the equipment during its operation.

The number of raw or starting materials used in the production of the finished products is quite limited. Magnesium ingots, powders, and chips constitute the primary raw material. Magnesium/aluminum alloys may also be used as starting materials, but the frequency of this is much less and they constitute a relatively small fraction of the total material processed. Salt coated magnesium forms, zinc, and fluorospar comprise the remaining materials used in production. Talc is kept on hand at all work stations for purposes of fire suppression. A variety of other materials are used by maintenance, janitorial, quality assurance, and office personnel. These materials include paints, welding supplies (primarily for use on carbon steel), oils, fuels, cleaning products, analytical reagents, and office equipment chemicals. Lime had been used in the past to mix with magnesium powders for specific products and had been reported by the workers to have caused skin irritation and burns, but the use of lime for this particular purpose has reportedly been discontinued.

C. Engineering Controls, Work Practices, and Personal Protective Equipment

Equipment at all work stations is grounded according to the National Fire Protection Association standards. Process enclosures, local exhaust systems, or both are present on the majority of equipment used in production, especially the grinding units. Company policy prohibits the operation of equipment in closed buildings; therefore, production equipment is used only when all doors can be opened. This policy is enforced year around. All powdered material is stored in closed drums when it is not being processed. Since the operations are primarily batch operations, excess feed and finish material is not usually permitted to accumulate around the equipment or in the work areas. Additionally, many of the operations can be monitored remotely once they have been started and can also be shut of remotely if a problem should develop. Operations processing the finer powders are, in some instances, not run when workers or workers other than the primary operator are present in the area.

Incorporated with the engineering controls to prevent dust generation or release and the individual work practices are the housekeeping efforts required of each shift. Each worker is required to clean up his/her work area by sweeping. Cleaning of process equipment also occurs during down periods, prior to equipment or product changes. Many workers clean their areas regularly during the shift. The company also reports that the buildings housing the production equipment are swept and washed down periodically during the year.

Personal protective equipment required of all workers includes: safety shoes, hard hats, hearing protection, and - where needed - safety glasses. Workers processing the finer magnesium powders and performing screening operations are required to wear flame-retardant coveralls. These same coveralls are available as an optional item for all other production workers. Nuisance dust respirators are available for the workers, but no mandatory respiratory protection areas have been designated.

D. Workforce Demographics, Job Classifications, and Job Duties

The company employs about 60 hourly workers. Except for the office staff, the entire workforce is male. Average tenure among the workers is seven years, with a range of less than one to 25 years. Production operations run three shifts per day, five to seven days per week. The breakdown of the various job classifications among the various workers is as follows:

General Operators	72%
Blender Operators	5%
Maintenance	12%
Yardmen	7%

Warehousemen, Rotap Operator, Truckdriver, and Janitor--each less than 2%.

Table I presents the various job titles, along with a breakdown of maintenance and other job classifications, and the general duties of each. Workers can be and are assigned to work on various pieces of equipment at the different work stations throughout the facility.

E. Medical and Industrial Hygiene Resources and Programs

RMC has no on site or corporate industrial hygiene programs and has not had any industrial hygiene surveys conducted in the past other than OSHA inspections. No data concerning past exposures to materials used or generated by the process are known to exist.

The company utilizes the services of a local physician for all pre-employment examinations and required medical care. Annual audiograms and triennial chest x-rays are done by an outside contractor.

IV. EVALUATION DESIGN AND METHODS

A. Industrial Hygiene

Full-shift personal and area sampling was conducted for exposures to magnesium and aluminum dusts using 37 millimeter mixed cellulose ester filters sampling connected via flexible tubing to personal sampling pumps calibrated at a flow rate of 2 liters per minute. The sampling pumps were checked periodically during the day to assure that they were functioning properly. This also provide an opportunity to discuss with the workers and observe the various tasks performed during the work shift. About 15 percent of the filter samples were screened for 26 metals other than magnesium and aluminum to determine if any other metals of concern may be present, although the two metals mentioned were considered to be the materials of primary interest.

1. Metals Screen by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES):

   Nine of the sixty filter samples collected were analyzed using NIOSH Method No. 7300.[1] Samples were ashed with 4 milliliters (mL) HNO_3 and 1 mL $HClO_4$ and then diluted to 25 mL after digestion. A sequential scanning inductively coupled plasma emission spectrometer was used for all measurements.

   The limit of detection (LOD) for the elements analyzed by the ICP/AES method are listed in Table II.

2. Analysis of Filter Samples for Magnesium and Aluminum by Atomic Absorption Spectroscopy (AAS):

   The remaining filter samples were analyzed for magnesium and aluminum by AAS according to NIOSH Method P&CAM 173.[2] Samples were brought to a final volume of 25 mL. The LODs were estimated to be: 0.2 micrograms (ug) per sample for magnesium and 7 ug/sample for aluminum. The limits of quantitation were estimated to be 0.41 ug/sample for magnesium and 23 ug/sample for aluminum.

3. Bulk Sample Analyses for Trace Metals, Silica and Particle Size, and Fiber Identification

   Two bulk samples of fluorospar and talc, in use at the time of the NIOSH study, were collected and analyzed for trace metals, silica and particle size distribution, and the presence of asbestiform fibers.

   a. Analyses for Trace Metals

      Three replicate aliquots of each sample were weighed (approximately 0.06 grams) and then digested with aqua regia and perchloric acids. The residues were dissolved in a 4% nitric-1% perchloric acid solution and analyzed for trace metals content by ICP-AES. The limit of quantitation for this sample set was 0.01%.

   b. Analyses for Silica and Particle Size Distribution

      i. X-ray Powder Diffraction (XRD):

A portion from each sample was "backpacked" on XRD holders and analyzed qualitatively by step scanning from 16 to 52 degrees (2-theta) at a rate of 0.02 degrees per sec. Copper X-radiation (40 KV and 35 mA) was used for the analyses. The resulting diffractograms were manually compared to the pure reference patterns of the three silica polymorphs - quartz, cristobalite, and tridymite.

ii. Particle Sizing:

Each one of the bulk samples was analyzed by laser velocimetry utilizing a TSI Model APS 33 computer-controlled aerodynamic particle analyzer, which has a range of 0.5 to 30 micrometers.

c. Fiber Identification by Transmission Electron Microscopy (TEM)

A portion of each of the two bulk samples was ultrasonicated in 20 mL of ethyl alcohol, and aliquots of the resulting mixture were evaporated onto a carbon-coated copper grid and examined on the Philips 420 TEM at 1750 X and 5000 X magnification. Elemental spectra were obtained during the analysis.

B. Medical

All production and maintenance employees were invited to participate in the medical evaluation. Personal letters were sent to the employees' home addresses describing the study and offering further information on request. The employees had the option of participating in some or all components of the study.

The medical evaluation was designed to evaluate all the known acute and chronic effects of exposure to magnesium, as well as potential or suspected effects of metal dust exposure. These included skin and respiratory effects, as well as one literature report of peptic ulcer disease among magnesium workers.

The medical evaluation included a questionnaire, a limited physical examination, pre-shift and post-shift pulmonary function tests, and a review of previous chest X rays.

All results were maintained in a confidential manner. A report of individual test results were mailed to the home address of the employee. Data were otherwise reported only in composite.

A standardized questionnaire developed and approved by the NJDOH Institutional Review Board was used for the study. The questionnaire was administered over the telephone by NJDOH personnel. It was designed to elicit signs and symptoms of eye, nose, and throat irritation, lung problems, and skin irritation. Information was also obtained about non-workplace exposures which are associated with such medical problems. Employees were asked to list all job titles held and the number of months worked at each job title since entering the work force at Reade. Current job titles were available from the company. Information was obtained about potential exposures for jobs at previous places of employment.

A standardized physical examination was conducted at the workplace by physicians. The examination included inspection of the skin, auscultation of the lungs, and testing of peripheral nerve reflexes.

Pulmonary function tests were administered before and after the workshift by an American Thoracic Society (ATS) certified technician utilizing equipment that met ATS specifications. Blood samples were obtained during the shift for determination of magnesium and calcium levels. Venous blood was collected in 10 cc Vacutainer tubes which were transported to the laboratory for analysis the same day.

Triennial chest X rays taken by the employer were made available for the study. The most recent X ray for each participating worker was reviewed by a "B-reader" hired as a consultant to the NJDOH. X rays were intrepreted according to the International Labor Organization.[3]

Pulmonary function tests (PFTs) were compared to standard values based on height, weight, age, race, and sex. A reduction below 80% of the predicted force vital capacity (FVC) was taken as suggestive of restrictive pulmonary disease. A ratio of the forced expiratory volume at one second (FEV_1) over the FVC less than 80% of predicted was taken as suggestive of obstructive pulmonary disease.

As measured directly by an exposure-duration index there were not enough unexposed individuals to compare their test results with exposed individuals. Similarly there were not enough individuals with abnormal physical findings or laboratory tests to compare them to normal individuals. Instead, the analysis focused on comparing pre-shift with post-shift values FEV_1/FVC.

V. Evaluation Criteria

A. Fire Protection and Safety Criteria:

The primary sources of fire protection and safety criteria used as guides for evaluating the hazards posed by workplace exposures in this facility were: (1) the National Fire Protection Association (NFPA) Standard for the Manufacture of Aluminum and Magnesium Powder[4]; (2) NFPA Standard for the Storage and Processing of Magnesium [5]; and (3) Occupational Safety and Health Administration (OSHA) Standards.[6]

Magnesium is referred to as a combustible metal due to the ease of ignition of thin sections of granules and fine powders of the metal. The minimum explosion concentration of milled magnesium is 30 g/m^3, the minimum cloud ignition energy is 40 millijoules, and the ignition temperature is 560 degrees Centigrade. Magnesium powder that is slightly wetted with water may generate sufficient heat to ignite spontaneously in air, burning violently as oxygen is extracted from the water with the release of hydrogen. Common extinguishing methods do not work well with magnesium fires. Burning magnesium reacts violently with halogenated hydrocarbons. Water spray increases the intensity of a magnesium fire, and burning magnesium continues to burn in atmospheres of carbon dioxide or nitrogen. Only dry powder extinguishing material (Class D extinguishing agent), including talc and sand, suitable for use with combustible metals should be used.

B. Evaluation Criteria for Chemical Contaminants

1. Environmental Exposure Criteria

As a guide to the evaluation of the health hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 if 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 evaluation 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 increase 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)[7], 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs)[8], and 3) the U.S. Department of Labor (OSHA) occupational health standards.[6] Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

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 short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

2. Magnesium

Magnesium is an essential element for human physiology, functioning in many vital enzyme systems. Blood levels of magnesium must be maintained within a specific range in order to sustain life.

Other than occupational risks of conflagration and eye/nose/throat irritation, magnesium has not been reported as a major occupational hazard.[9]

There is little toxicological information available on the non-oxidized form of magnesium used at Reade. This may result from the fact that magnesium production, particularly in the U.S., has been confined to a relatively small group of workers, and that few medical researchers have had the occasion or impetus to conduct adequate toxicologic or epidemiologic investigations. In addition, the explosive nature of magnesium compels dust control and therefore limits occupational exposure.

Respiratory exposure to magnesium oxide fumes can result in metal fume fever, a reversible syndrome with manifestations that include fever, chills, muscle aches, and respiratory symptoms. [9,10,11] This illness typically occurs as a result from exposure to metal oxide dusts and does not result from exposure to metal oxide dusts. Occular, nasal, and throat irritation are reported to result from occupational exposure to magnesium dust. Increased rates of peptic ulcer disease have been reported in a cohort of workers producing magnesium from dolomite. The route of exposure or even mechanism of causation were not addressed.[12]

There are no authoritative environmental evaluation criteria specific for magnesium dust. The ACGIH has a TLV for magnesium oxide fume of 10 mg/m^3, but this is not applicable to the exposures to metallic magnesium documented in this study. The ACGIH TLV is based on the occurrence of metal fume fever following the inhalation of freshly generated magnesium oxide fume.[13]

VI. RESULTS

A. Safety

The findings of the safety inspection are presented in detail in Appendix A. No serious or immediate safety hazards were identified during the survey. The company exhibited a high degree of awareness and support for the safety program and fire and safety measures present at the plant. Workers were universally aware of the hazards and precautions to be taken in association with handling and processing magnesium.

B. Industrial Hygiene

1. Personal Exposure and Area Sampling for Metals:

The ICP-AES analyses of selected samples identified in Tables III and IV showed no detectable arsenic, silver, boron, barium, beryllium, cadmium, cobalt, chromium, copper, lanthanum, nickel, lead, antimony, selenium, tin, tellurium, titanium, thallium, vanadium, yttrium, or zirconium. Small amounts of manganese (less than (<) 0.01 mg/m^3, 2 of 9 samples), molybdenum (<0.01 mg/m^3, 4 of 9 samples), and zinc (<0.02 mg/m^3, 6 of 9 samples) were identified in several of the samples. Calcium and iron were common to all of the samples analyzed by ICP-AES.

Table III presents the area sampling results for magnesium and aluminum. Airborne concentrations of magnesium ranged from 0.01 mg/m^3 to 1.8 mg/m^3, with an arithmetic mean concentration of 0.41 mg/m^3 (standard deviation: 0.47). Airborne aluminum concentrations were for the most part below detectable levels. The highest quantifiable concentration was 0.18 mg/m^3.

Table IV presents workers' personal exposures to magnesium and aluminum dusts. The comments column indicates if the workers wore respirators, which may have reduced their individual exposure to varying degrees. Magnesium exposures ranged from 0.01 mg/m^3 up to 17.2 mg/m^3. The mean exposure was 1.7 mg/m^3, (standard deviation 3.2). Sixty percent (25 of 42 samples) were below 1 mg/m^3. Aluminum dust exposures ranged from non-detectable (ND) to 1.6 mg/m^3. Fifty percent (21 of 42) were below detectable levels.

The bulk sample analyses for trace metals indicated the presence of trace amounts (less than about 0.5% by weight) of aluminium, iron, magnesium, yttrium, and zirconium in the fluorospar sample. Calcium was the primary metal present. Sodium constituted 1.3% by weight of the sample. Metals present in the talc bulk sample were: aluminum, calcium, chromium, manganese, and nickel in trace amounts; iron, 3% by weight; and magnesium as the primary metal. Silver, arsenic, barium, beryllium, cadmium, cobalt, copper, lithium, molybdenum, phosphorus, lead, platinum, antimony, selenium, tellurium, titanium, thallium, vanadium, and zinc were all below quantifiable levels of 0.01% by weight in both materials.

The diffraction patterns of quartz, cristobalite, and tridymite were not detected in the qualitative scans of either the fluorspar or talc. The detection limit was about 1%. Amorphous silica was not present in either sample.

The particle-sizing results for the two bulk samples of material indicated that about 60% of the fluorspar sample fell into the respirable size range (<10 um), while about 70% of the talc sample particles were of a respirable particle size. These particle size distributions are for the bulk samples and indicate that both materials contain a significant amount of material that could be inhaled if it were to become airborne.

The results of the TEM analyses for fiber content in the fluorspar and talc samples indicated that no asbestos fibers were present. The results are present in Table V.

C. Medical

Of the 66 production and maintenance employees identified as potentially exposed to magnesium dust, 37 (56%) agreed to participate in one or more parts of the health study (Table VI). There were 28 who completed all parts of the medical survey. Of the 32 workers who completed the questionnaire, only six had worked in more than one job title at Reade. Months worked at Reade ranged from one to 323, with an average of 65. Almost 25% of the employees had worked there less than one year, and half had been employed less than five years. Three workers had been employed at the facility 10 years or more.

In the absence of historical exposure monitoring and since job title was not useful as an estimate of exposure, the workers' exposure was estimated by duration of employment. Two arbitrary exposure categories were established, less than five years and five years or more employment at the facility. There were 16 workers in each exposure group. Average employment was 16 months for the first category and 115 months for the second category.

Blood assays for magnesium were conducted on 35 study participants. Assays for calcium were conducted on 33 samples, with two samples lacking sufficient volume for both tests. Serum magnesium concentrations ranged from 1.4 to 1.9 mEq/l (normal 1.3 to 2.1) and serum calcium concentrations ranged from 9.2 to 10.7 mg/dl (normal 8.5 to 10.6).

All workers were males. There were 32 non-Hispanic whites and one Hispanic worker, with four workers not indicating race. Their ages ranged from 18 to 62, with a median of 36 years. Among the 32 workers who answered the questionnaire there were 14 current smokers and 8 former smokers. The average smoking history was 11.2 pack years, ranging from 0.2 to 37.5 pack years. Current smokers averaged 1 pack a day. There were 9 smokers among those working less than five years, with an average consumption of 10.7 pack-years. There were 13 smokers among those working five years or more, with an average consumption of 11.3 pack-years. There were two cigar smokers and no pipe smokers.

Eye, nose, and throat irritation were commonly reported symptoms (Table VII). Runny nose, stuffy nose, and frequent sneezing were commonly experienced, with over half the workforce experiencing at least one of these symptoms. Nosebleeds were infrequently reported. A chronic cough was reported by six workers (19%), all of whom were current smokers. Allergic medical problems were less commonly reported. Sinusitis and/or hayfever were reported by nine workers (Table VIII). Six workers reported the symptoms to be present before employment at the facility.

Lower respiratory symptoms were reported by the workforce less often than upper respiratory symptoms (Table IX). Chronic bronchitis was defined as a productive cough occuring most days a month for at least three months a year for two or more years. Of the four workers reporting chronic bronchitis, all were current smokers. Of the six workers reporting shortness of breath with activity, two were smokers and two were former smokers. Few of the workers reported physician-diagnosed medical conditions related to the lower respiratory system (Table X). No cases of tuberculosis or emphysema were reported.

Physical Examination

Three workers had abnormal lung findings. Two of the three were wheezing, one with a long history of asthma and the other with a history of hayfever. The other worker had a few persistent end respiratory rales; he had a history of mild shortness of breath. All three workers had normal chest X rays. No neurologic pathology requiring medical follow-up was detected. All those individuals with persistent dermatologic complaints that they associated with their employment had manifestations of these conditions on physical examination.

Pulmonary Function Tests

There were 34 workers who participated in pre-shift pulmonary function tests. Two workers failed to complete the post-shift pulmonary function tests. Six workers had abnormal pulmonary function tests. Three had minimally obstructive pattern, and one had severely obstructive pattern. The workers with minimally obstructive pattern had durations of employment of 1, 2, and 17 months. The workers with minimally restrictive pattern had durations of employment of 91 and 94 months. These individuals had no history of smoking or exposure to fibrogenic dust. The worker with severely obstructive pattern had an unknown duration of employment but was less than 25 years old.

Two of the workers, one with a restrictive pattern and the individual with the severely obstructive pattern, were wheezing during their physical examinations. Both had previous medical histories of asthma or wheezing.

The pre-shift and post-shift FEV1/FVC % values for each individual are compared in Table XI. No individual had a decrement suggestive of occupational asthma. There were an equal number of individuals with positive and negative changes in FEV1/FVC % over the workshift.

Chest X rays

Thirty-four workers with chest X rays, only one was deemed unreadable by the B reader. Of the 33 that were read by the B reader, 27 were normal. Two of these had ILO readings of 0/1 for irregular opacities. This suggests the possibility of scarring such as occurs with fibrous mineral exposure. Three individuals had pleural thickening such as occurs with exposure to asbestos or other fibrogenic minerals. Two had unilateral oblique pleural thickening and one had a diaphragmatic plaque. This last individual was 0/1 for medium sized irregular opacities. This reading indicates the possibility of parenchymal scarring from asbestos or other minerals with similar biological activity. Two of these individuals had been employed at this site sufficiently long that their abnormalities could have resulted from exposure at Reade, but no exposure to asbestos or other fibrogenic mineral fibers has been documented at this site. Four individuals had cardiac or hilar abnormalities not known to be related to exposure to fibrogenic dust. Of the remaining four workers, three had pleural thickening (Table XII). Their durations of employment ranged from 2.5 to 10.5 years. None of these workers reported previous employment dealing directly with asbestos, although one had handled building materials. The fourth worker, who had been employed less than 1 year, had small opacities in his lung fields. The physical examinations and pulmonary function tests were normal for the four workers.

There were seven workers who thought they had developed a skin problem since starting work at the facility (Table XIII). Of these individuals, one associated his problem with water contamination not associated with the facility and the other no longer had the condition because the precipitating exposure no longer occurred. The remaining individuals had acneform erruptions (3), seborrheic dermatitis (1), and eczematous dermatitis (1).

Possibility of ulcer disease was given the arbitrary clinical definition of at least weekly episodes of an upper abdominal burning pain which responded to food or antacids. These complaints are not specific, and in general other gastrointestinal illness and occasionally cardiac illness will also give these symptoms. Seven workers had symptoms meeting this definition.

VII. DISCUSSION AND CONCLUSIONS

A. Safety

The major safety concern in this facility is the potential fire and explosion hazard resulting from the manufacture and handling chips, granules and, powders and magnesium-aluminum alloy powders. The greatest potential for fires and explosions appears to be in the ultrafine magnesium grinding and screening operations. The company did not have a record of the fires and explosions that have occurred. According to the company, there were more fires than explosions. The fires were normally limited to drum fires occurring at the cyclone collector. This is probably due to the air flow through the grinder and blower units. Any burning material in the grinder tends to move through the duct work and the cyclone collector to the drum, thereby avoiding an explosion in the grinder. Explosions normally occurred at the ultrafine grinding and screening operations. Damage was limited due to explosion protection devices on the duct work. Workers were not in the areas at the time of the explosions.

The causes of ignition were anything that can cause sparking in the machinery (e.g., tramp metal, broken screens, loose rivets, etc.). Workers appeared to have a full awareness of magnesium chips and powder as a fire/explosion hazard.

Local exhaust hoods located at one of the blending areas have deficiencies in the hood design that prevent effective capture of dusts generated during the blending operation. The door to the building containing this process were open, thereby limiting the concentration of airborne dust.

One of the concerns expressed by the workers interviewed included the proximity of the operator and subsequent risk of a burn injury when magnesium fires occurred in a manual feed grinder. This unit was used for grinding brittle magnesium-aluminum alloys. Unlike the other operations, the workers must remain at the unit inside the building during its operation.

Another worker concern was the handling of damaged drums. Normally, drums are rolled on their edge to and from pallets to position the drum for either loading a hopper or for filling the drum at a collection unit or screening operation. The weight of a filled drum varies but a typical filled drum might weigh 200 pounds. When a damaged drum is rolled, the flat side of an edge can cause a jerking action to the body, resulting in pulled shoulders, wrist and hand injurines, and other similar injuries. This was supported by the types of injuries reported on the OSHA 200 forms. The company presently has a policy of replacing the damaged drums.

The housekeeping measures in place and emphasis on these activities were very good.

B. Industrial Hygiene

Two workers were identified as having substantial magnesium exposures (greater than 10 mg/m^3 as a time weighted average (TWA) for their full-shift exposure). Exposures fell into three general levels: (1) above 10 mg/m^3 TWA, (2) 1 to 5 mg/m^3 TWA, and (3) less than 1 mg/m^3 TWA. Although the toxicity of magnesium metal itself does not appear to be of great concern, the reactivity of the metal warrants that elevated dust levels be avoided.

D'Andrea et al. describe round lung opacities in workers engaged in magnesium production, but does not provide any quantitative levels of worker exposure to magnesium.[14] Of the four cases discussed, neoplastic origin of the lesion in one case is ruled out based on surgical and histological findings, suggesting a pneumoconiotic etiology. The authors suggest an interpretation of circumscribed pneumoconiotic lesions caused by occupational inhalation of dust resulting from magnesium production, especially dolomite.[15] One should note that this article appears to be concerned primarily with individuals engaged in the actual production of magnesium, an operation unlike that at Reade Manufacturing, were the process is strictly a mechanical reduction in size of the metallic magnesium.

The issuance of respiratory protection to the workers necessitates the implementation of a respiratory protection program. Although some workers wear respirators, we observed many instances of improper respirator wearing and bearded workers with respirators. These conditions negate the effectiveness of the respirator and may present the worker with an actual inhalation exposure close to that measured in the worker's personal sample.

In general, the only exposures the workers had were to the magnesium and aluminum dust.

C. Medical

This study was limited in part by incomplete participation by the workforce. About half the eligible workers participated to any degree.

No participant had a blood magnesium level suggestive of absorption and accumulation of biologically significant amounts of magnesium. In the absence of any known relationship between magnesium dust exposure and adverse health outcomes, coupled with the relatively low dust levels measured at the facility, only limited conclusions can be drawn.

The reported association of skin problems with work does not suggest a single agent or process as being the etiologic factor. The individuals involved would benefit from additional evaluation of the role of work activities in the development of their skin problems.

The finding that at least half the individuals examined had some nasal symptoms may indicate that magnesium dust acts as a irritant to exposed tissues. An irritant effect may be responsible for some of the skin problems reported by workers to be related to work. Symptoms such as wheezing and chronic cough did not appear frequently in the workforce and could not be associated with exposures.

There were two workers with a minimal restrictive lung pattern on PFT. Neither individual had ever smoked or had known exposure to fibrogenic dust. Regular pulmonary function testing of these individuals is indicated.

Three workers had pleural thickening on chest X ray. This finding is associated with, but not specific for asbestos exposure. Talc can have asbestos contamination and is present in the facility as a fire control measure, although assays of currently used material did not reveal asbestos.

VIII. RECOMMENDATIONS

A. Safety

1. Work assignments should be planned so that an organized crew (fire squad), trained in fire fighting, is in or close to the processing operations at all times during operation. Only trained personnel should be permitted to the engage in fire control activity. All others should be evacuated from the area.

2. Records should be kept of all fires and explosions occurring at the facility.

3. The existing procedure of manual handling of the drums should be evaluated to ensure workers' safety when handling the drums. One possible change is to use 2-wheeled, hand trucks to move the drums. If hand trucks are used, they should have non-sparking, static conductive tires and wheels which have been bonded through or around the lubricating film in the bearings.

4. The existing manual feed grinder operation should be inspected and evaluated to ensure workers' safety when they operate

equipment. One possible change is to provide a remote conveyor belt feed to the equipment.

B. Industrial Hygiene

1. The exhaust ventilation hood located at the fine material blender should be modified to more effectively capture the dusts generated during drum filling. This may be done through the use of flanging, or possibly with the flexible hood arrangement.

2. The issuance of respiratory protection by the company and the required use of respirators in certain areas or on certain processes necessitates the development of a respiratory protection program in compliance with the OSHA respiratory protection standard, 1910.134. Development of an official policy pertaining to the use of respiratory protection for employees wearing beards is also required.

3. Eye protection should be provided for all workers in the production and support areas of the plant. The use of cutting and grinding equipment generating metal chips and particulate of various sizes, and the occasional fires or incidents involving magnesium dusts, and equipment indicate a need for protection of the eyes in the event flying foreign material is suddenly released in the work area. Due to the potentially serious nature of such an injury, there should be a safety program for eye protection utilizing safety glasses, goggles etc., plantwide. Use of contact lenses while at work should be prohibited.

4. Workers can reduce the exposure to irritating dusts through several means. Clean clothing giving adequate protection of the extremities should be worn. Strong cleansing agents used on the job can be replaced with less abrasive or drying cleaners. Showering after work should be encouraged.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technicxal Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Reade Manufacturing Company
2. Employee Relations Committee Labor Representatives, Reade Manufacturing Company
3. Confidential Requestors
4. NIOSH, Boston Region
5. OSHA, Region I

For the purposes of informing the approximately 70 "affected" workers, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

Job Classification and Job Description
Reade Manufacturing Company

Lakehurst, New Jersey
HETA 86-231

May 1987

Department	Job Classification	Responsibilities
Production	General Operator	Works in any of the general production jobs. These include chipping, grinding, screening, crushing, or any other general production work required. Workers are swithched frequently among the jobs as production requirements change.
	Yardman	Operates lift truck to supply production units operating with raw materials and removes finished goods. Depending on workload, may also operate a production unit as well.
	Warehouseman	Responsible for shipping and receiving. Runs lift truck, labels drums, weighs and logs in/out materials.
	Blender Operator	Works in one of three blenders, blending and packaging materials to customer specifications.
	Rotap Operator	Works in rotap room performing product size checks on in-process and finished materials. Operates rotap machine.
Maintenance	Light Maintenance	Works on repairs to mobile equipment, building and grounds repairs, refills propane bottles, maintains some production tooling.
	Heavy Maintenance	Works on repairs to production equipment. Handles minor electrical and all mechanical repairs on production equipment.
	Screen Maintenance	Fabricates, repairs, and installs grinding mill screens. Maintains and installs screening unit screens.
Other	Janitor	Maintains non-production areas of plant for personnel use. Normal janitorial duties.
	Truck Driver	Drives company car or truck, generally for pickup of needed supplies for plant.
	Painter	Paints plant buildings and equipment inside and outside, when utilized.

Table II

Metals Screened by Inductively Coupled Plasma-Atomic Emission Spectroscopy and Their Corresponding Analytical Limit of Detection (LOD)

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Analyte (Symbol)	LOD in Micrograms/sample
Aluminum (Al)	10
Antimony (Sb)	10
Arsenic (As)	5
Boron (B)	10
Barium (Ba)	1
Beryllium (Be)	1
Calcium (Ca)	5
Cadmium (Cd)	1
Cobalt (Co)	1
Chromium (Cr)	1
Copper (Cu)	1
Iron (Fe)	1
Lanthanum (La)	5
Magnesium (Mg)	1
Manganese (Mn)	1
Molybdenum (Mo)	1
Nickel (Ni)	1
Lead (Pb)	2
Selenium (Se)	10
Silver (Ag)	2
Tin (Sn)	10
Tellurium (Te)	10
Thallium (Tl)	10
Titanium (Ti)	10
Vanadium (V)	10
Yttrium (Y)	1
Zinc (Zn)	1
Zirconium (Zr)	10

Table III

Area Sampling Results for Magnesium and Aluminum

Reade Manufacturing Company
Lakehurst, New Jersey

HETA 86-231
May 18-21, 1986

Date	Sample Description Location (Building)	Duration (minutes)	Airborne Concentration* (in mg/m^3) Mg	Al	Comments
5/18	15	252	0.75	0.02	Unit processes sweepings, ICP-AES
5/18	6	311	/0.04	ND	On scale in Building 6
5/18	30	369	1.8	0.18	B collector, grinders, ICP-AES
5/19	30	407	0.31	Trace	Between collectors A & B
5/19	6	384	0.17	ND	Mounted on scale
5/19	6	389	0.36	ND	Rotap room, shelf above bench
5/19	23	378	0.02	ND	Exterior S side, facing ultrafine
5/19	36B	368	0.43	ND	Below mezzanine, behind screen unit
5/20	5	351	0.64	ND	By feed hopper to screen
5/20	6	340	0.22	ND	Mounted on scale face housing
5/20	18A	298	0.01	ND	Exterior wall, collector side
5/21	5	465	0.45	ND	Left of screen feed hopper
5/21	18A	453	0.04	ND	Inside wall, opposite crusher
5/21	31	446	0.83	ND	Right of screen feed hopper
5/21	28	423	0.09	ND	Front of building 28, facing collector

* Concentrations are presented as time weighted averages over the sample duration in milligrams per cubic meter of air (mg/m^3). "/" denotes that the concentration is an approximation due to sampling pump malfunction. "Trace" denotes that aluminum exposures fell between the analytical limits of quantitation and detection, indicating exposures less than about 0.02 mg/m^3. "ND" denotes that aluminum was not detected, i.e., less than 10 micrograms per sample.

ICP-AES Denotes samples screened for the metals listed in Table II.

Tabl(

Worker Exposure Sampling Results (or Magnesium and Aluminum

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 18-21, 1987

Date	Sample Description Location (Building)	Job Title	Duration (minutes)	Airborne Concentration* (in mg/m^3) Mg	Al	Comments
5/18	6	Blender Operator	375	0.92	0.07	Weighing, transferring, banding drums
5/18	32	General Operator	463	0.28	ND	Operates two grinders, wore respirator
5/18	Yard	General Operator	474	0.15	0.02	Fork lift driver, ICP-AES**
5/18	34	General Operator	511	2.2	0.01	Wore respirator, ICP-AES
5/18	36B	General Operator	437	1.5	ND	Wore respirator
5/18	22	General Operator	313	0.6	ND	Chipper machine
5/18	30	General Operator	485	12.6	1.2	Wore respirator, change filters at noon
5/18	25	General Operator	478	0.58	0.51	Grinding Mg/Al alloy, ICP-AES
5/18	N/A	Warehouseman	459	0.63	0.06	Escorted NIOSH investigators
5/18	14	General Operator	414	0.36	0.03	Working scrap table
5/19	6	Blender Operator	498	0.31	Trace	Weighing, transferring, banding drums
5/19	46	General Operator	479	2.5	0.23	Wore respirator, operated screen
5/19	Yard	General Operator	483	0.09	ND	Operated lift truck
5/19	36B	General Operator	481	0.68	ND	Wore respirator, operated screen
5/19	Yard	Forklift Operator	436	0.2	ND	Operated lift truck
5/19	30	General Operator	484	1.9	0.16	Wore respirator
5/19	15	General Operator	502	2.8	0.02	Wore resp., operated screen, ICP-AES
5/19	N/A	Warehouseman	476	0.14	ND	Escorted NIOSH investigators
5/19	14	General Operator	447	0.16	ND	Crusher operator
5/20	Yard	Yardman	510	0.08	ND	Forklift driver
5/20	34	General Operator	492	1.5	ND	Operating grinders
5/20	14	General Operator	486	0.06	ND	Crusher operator, wore respirator
5/20	6	Screen Operator	434	2.9	0.25	Screen 4C, wore respirator

Table IV (con't)

Worker Exposure Sampling Results for Magnesium and Aluminum

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 18-21, 1987

Date	Sample Description Location (Building)	Job Title	Duration (minutes)	Airborne Concentration* (in mg/m^3) Mg	Al	Comments
5/20	31	Screen Operator	494	17.2	ND	Wore resp. when handling loose material
5/20	5	None given	503	1.9	ND	Wore resp. ran chipper and screen
5/20	32	General Operator	486	0.39	ND	Wore respirator, ran grinder
5/20	4	General Operator	512	1.1	ND	Chipping and grinding stock
5/20	29	General Operator	392	1.7	1.5	Wore resp. screening Mg/Al alloy
5/20	21	General Operator	468	0.17	ND	Ran chipping unit
5/20	18A	General Operator	431	0.38	0.03	Wore resp. ran small crusher
5/20	38	Maint. Supervisor	440	0.01	ND	Heavy maintenance shop
5/20	38	Maintenance	255	0.03	0.02	Heavy maintenance shop, ICP-AES
5/21	26&27	General Operator	512	4.4	0.17	Wore resp. ran Mg/Al and Mg grinders**
5/21	22+	Screen Operator	473	0.54	Trace	New employee, ran chippers, screens
5/21	31	Screen Operator	494	2	ND	Wore respirator
5/21	5	None given	513	0.82	ND	Wore resp. screening material
5/21	32	General Operator	477	0.48	ND	Operating grinder
5/21	4	General Operator	514	2.3	0.01	Wore resp. operated mills, ICP-AES
5/21	38	Maint. Supervisor	422	0.05	ND	Heavy maintenance shop
5/21	21	General Operator	487	1.2	Trace	Operated screens in Bldgs. 33&36A
5/21	18A	General Operator	485	0.67	0.06	Wore resp. operated small crusher
5/21	29	General Operator	462	1.7	1.6	Wore resp. screening alloy material

* Concentrations are presented as time weighted averages over the sample duration in milligrams per cubic meter of air (mg/m^3). "Trace" denotes that aluminum exposures were detectable but below the analytical limit of quantitation. "ND" denotes the metal was below the analytical limits of detection for that the particular sample (Non-Detectable). Mg = Magnesium; Al = Aluminum.

** Samples were screened for metals listed in Table II.

Table V

Transmission Electron Microscopic Analyses of Bulk Samples for Asbestos

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Sample Identity	Appearance	Asbestos Content	Comments*
Fluorspar	Pale violet, grainy powder	None	Gypsum needles <0.1-0.2 um wide; 1-2 um long. See note 1.
Talc	Eggshell powder	None	Talc fibers <1% of material examined. (@ 1 um side, 20-30 um long). Trace talc fibers (<0.1 um wide @ 6 um long). See note 2.

* Symbols and abbreviations used are: um = micrometer; < = less than; @ = at.

Note 1 Fluorspar (Fluorite - CaF_2), is a cubic mineral usually found in crystals or masses which do not cleave into fibers. It is observed as an accessory mineral in various igneous rocks and associated with many different minerals as calcite, dolomite, gypsum, quartz, apatite, and galena.

Note 2 Talc [$Mg_3Si_4O_{10}(OH_2)$] is a monoclinic mineral rarely found in crystalline form. Characteristically in low grade metamorphic rocks, talc is a secondary mineral formed by the alteration of magnesium silicates such as olivine, pyroxenes, and amphiboles.

TABLE VI

Employee Participation
Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Participation	Number
questionnaire, physical, pulmonary function	28
questionnaire, physical only	2
questionnaire, pulmonary function only	1
physical, pulmonary function only	4
pulmonary function only	1
questionnaire only	1
Total	37

TABLE VII

Eye, Nose, and Throat Symptoms Reported By
32 Workers at Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Symptom	Number	Percent
runny, stuffy or sneezing	18	56%
itching or burning eyes	12	38%
runny nose	11	34%
sneezing	11	34%
stuffy nose	9	28%
sore or scratchy throat	6	19%
chronic cough	6	19%
nosebleeds	2	6%

TABLE VIII

Diagnosed Allergic Medical Problems Reported
Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Symptom	Number	Percent
asthma	2	6%
sinusitis without hayfever	4	13%
hayfever without sinusitis	4	13%
sinusitis and hayfever	1	3%

TABLE IX

Lower Respiratory Symptoms Reported By 32
Workers At Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Symptom	Number	Percent
wheezing	11	34%
productive cough	8	25%
shortness of breath with activity	6	19%
chronic bronchitis*	4	13%
wheezing leading to shortness of breath	3	9%
hemoptysis	2	6%

* chronic bronchitis is epidemiologically defined as a productive cough occurring on most days for 3 consecutive months or more during the year for two or more years

TABLE X

Physician-Diagnosed Medical Conditions Reported By
32 Workers At Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Symptom	Number	Percent
pneumonia	6%	19%
peptic ulcer disease	3	9%
asthma	2	6%
bronchitis	2	6%
tuberculosis	0	0%
emphysema	0	0%

Table XI

PRE-SHIFT and POST-SHIFT PULMONARY FUNCTION TESTS

Reade Manufacturing Comnpany
Lakehurst, New Jersey
HETA 86-231
May 1987
FEV/FVC (%)

PRE-SHIFT	POST-SHIFT	CHANGE
76.8	76.3	-0.5
72.7	70.4	-2.3
72.1	69.4	2.7
77.8	78.8	1.0
84.0	84.1	0.1
86.4	85.5	-0.9
80.2	81.5	1.3
80.6	78.1	-2.5
85.3	86.5	1.2
79.6	84.6	5.0
78.0	76.0	-2.0
89.3	88.5	-0.8
76.8	81.7	4.9
81.3	81.0	-0.3
82.7	85.0	2.3
75.4	77.8	2.4
75.0	80.6	5.6
54.2	47.0	-7.2
82.5	84.6	2.1
72.6	78.1	5.5
87.5	90.0	2.5
84.2	79.9	-4.3
81.2	80.6	-0.6
86.2	84.3	-1.9
85.5	81.1	4.4
82.9	81.1	1.8
67.7	76.3	8.6
78.2	83.5	5.3
62.6	66.4	3.8
68.2	68.7	0.5
84.6	79.3	-5.3
81.7	79.2	-2.6

TABLE XII

Previous Chest X ray Findings Amongst 34
Employees At Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Case	Months worked	Findings
1	92	pleural thickening
2	29	pleural thickening
3	10	small opacities 1/0
4	128	pleural thickening

TABLE XIII

Skin Symptoms Reported Among 32 Employees
At Reade Manufacturing, Inc.

Reade Manufacturing Company
Lakehurst, New Jersey
HETA 86-231

May 1987

Symptom	Number	Percent
self-attributed work associated rash	7	22%
chronic skin problems	4	13 %
hives	1	3 %
eczema	1	3 %

Appendix A

Results of Survey Findings

The survey of the facility focused on both fire/explosion and general safety hazards. This permitted the observation of the operations of various equipment, the presence of engineering controls, use of personal protective equipment, work practices, and safety procedures.

The operations are conducted in individual, small, unvented structures. The majority of the buildings have more than 50 feet separation distance from each other. The buildings are designed so that the internal surfaces are readily accessible for cleaning. The floors are smooth concrete, with few openings where dust might collect. All buildings have at least two, separated exits. The doors are kep open during metal processing operations.

The basic material flow is from magnesium ingots, through chipper units (coarse chips) to various sized grinders (hammer mill units), through duct work to cyclone collectors, and into metal drums. The chips and powders are then sent through screening units to separate out the various mesh sizes (ranging from 3 to 325 mesh). The final product is stored in sealed metal drums for shipping.

Sealed drums of the material on pallets are transported between the buildings by fork lift trucks.

There are no remote start switches but there are remote stop switches for the machinery. All start/stop switches are within direct sight of the machinery. There is normally one general operator per building. Chipper units have from 2 to 4 operators. Much of the actual process monitoring is done remotely by the operator.

In the ultra-fine (325 mesh) metal powder operations, the operator monitors the equipment from a separate building and no personnel are allowed in the immediate vicinity of the building during operation of this equipment.

Class II/Group E explosion proof electrical fittings are used on all light fixtures, wiring, motors, and switches in the processing areas. The machinery, duct work, collectors, and collecting drums are electrically bonded.

All machines appeared properly guarded. Blowers and grinders are electrically interlocked so that the blower unit must be started prior to the grinder. Separators (rated for Class II/Group E locations) are located in the feed areas of the machinery to remove ferrous tramp metal in order to eliminate internal machinery sparking. In addition, machine design is such to eliminate internal sparking.

The processing machinery and the pneumatic collection systems are completely sealed to eliminate the discharge of metal powder to the building areas. No equipment is operated in closed areas where airborne dust might reach explosion concentrations. The air flow in the pneumatic system appears to be sufficient to eliminate dust collection in he duct work. All cyclone collectors are located outside the buildings containing the grinding units. In addition, pneumatic systems have explosion protection devices.

Workers are required to clean their work area at the end of the work shift, and many also perform some housekeeping during the shift. Housekeeping is combined in many instances with work practices to prevent excess magnesium chip or duct accumulations in the work area.

Local exhaust ventilation was present as an integral part of some of the process and maintenance operations. The blending operations for the fine powders had local exhaust ventilation for the blender filling and drum filling areas.

The majority of the maintenance operations (cutting, welding, etc.) took place in the maintenance building which was in a remote location removed from the work process operations. If maintenace was necessary in the process area, all machinery was de-energized and tagged out and the area cleaned of all magnesium dust. All machinery is inspected on a periodic basis.

No flame or spark-producing materials (e.g., matches, lighter, smoking materials, etc.) were allowed on workers in the process areas. Smoking was only allowed in designated areas. This information was also posted throughout the facility.

Class D fire extinguishing materials were located near all processing units. Signs were posted throughout the facility warning not to use water for fighting magnesium fires.

The company has written safety rules and safety procedures that are communicated to the employees both in writing and verbally. Signs posted at each work station were clear, legible, and identified the required personal protective equipment for that area, specific precautions to be taken concerning the process, and the hazardous nature of the material being processed. Safety training consists of on-the-job training, safety meetings, and class room training. A foreman is assigned safety responsibilities on a collateral-duty basis. A safety committee (3 employer representatives and 3 employee representatives) meets once a month to discuss safety concerns. The committee performs a walk-through inspection of the facility every two month. Records are kept of the meetings and inspections. Accident investigations are conducted. First line supervisors are trained in fighting magnesium fires.

There is joint training and coordination with the local volunteer fire departments on fighting magnesium fires at the facility.

There is a strict smoking policy. Any worker caught smoking cigarettes, etc. in the magnesium processing areas is immediately terminated from the company. Workers caught in spark producing actions (i.e., banging lids, hammering, etc.) are suspended for 3 days. Other safety rules are enforced as follows: 1st violation - reprimand; 2nd - reprimand and 3 day suspension: 3rd- reprimand and 5 day suspension; and 4th - termination of employment.

Workers are provided with personal protective equipment that includes hard hats, hearing protection (muffs), flame retardant coveralls, safety glasses and face shields, resprators, and an annual safety shoe allowance. All workers observed during the survey were wearing the required personal protective equipment.