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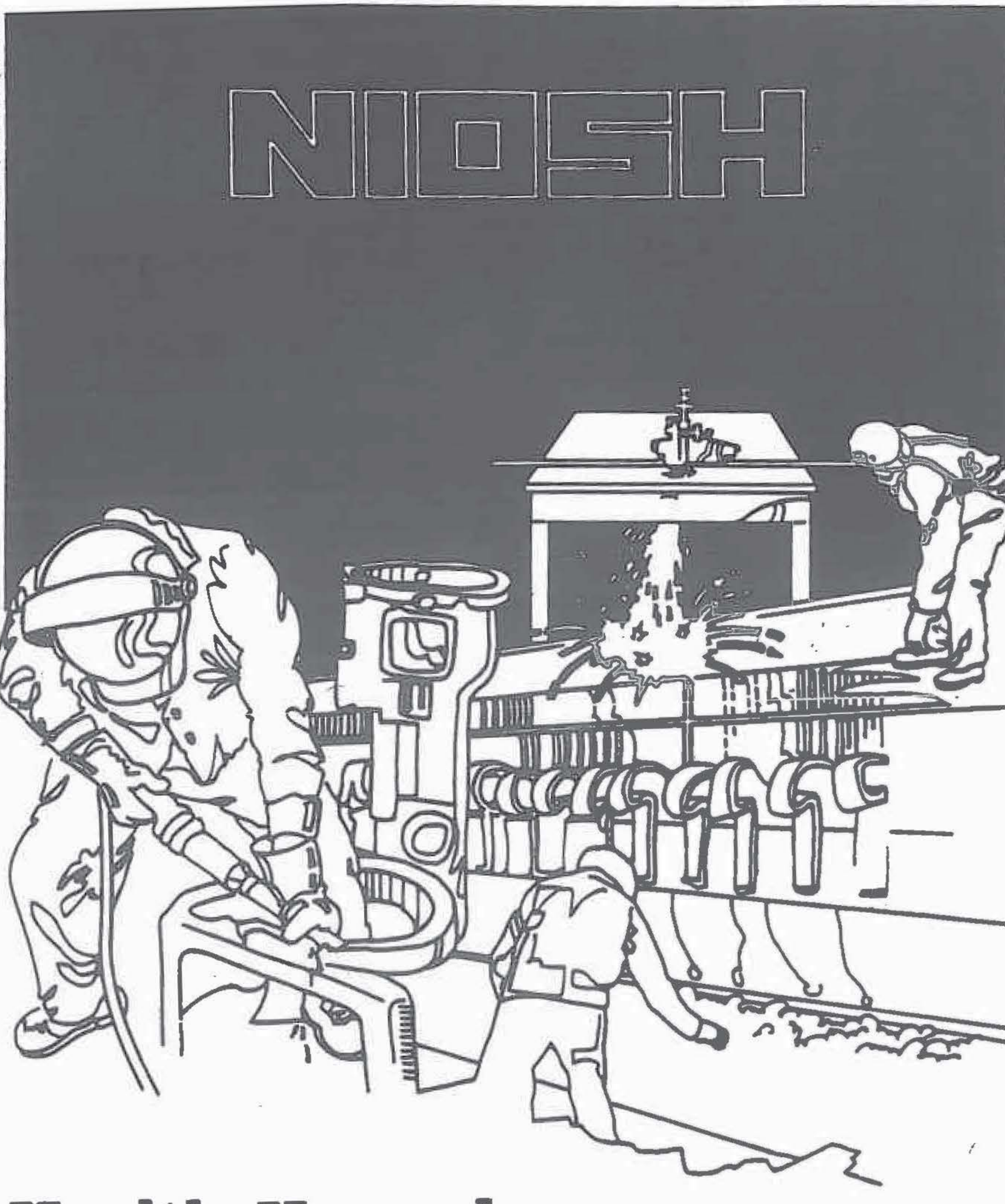

Health Hazard Evaluation Report

HETA 84-483-1669
NATIONAL ALUMINUM ROLLING DIVISION
SALISBURY, NORTH CAROLINA

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 84-483-1669
February 1986
NATIONAL ALUMINUM ROLLING DIVISION
SALISBURY, NORTH CAROLINA

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I. SUMMARY

On August 21, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate reports of respiratory illness occurring among workers in the Rolling Mill Department. Possible toxic substances present in the workplace included coolants used on the rolling mills and asbestos liners in the annealing furnaces.

National Aluminum, Rolling Division, custom rolls aluminum from coils to a gauge and quality of foil specified by the customer. Approximately 52 workers operate the Milling Department, three shifts per day, 5 to 7 days per week depending upon business. Coils that have been rolled on the mills may go through an annealing process to impart additional desired properties to the foil.

The NIOSH Health Hazard Evaluation included a walk-through survey (November 27, 1984) and follow-up personal exposure monitoring for kerosene, mineral spirits, a proprietary coolant additive, asbestos, and carbon monoxide (May 20-22, 1985).

Total kerosene time weighted average (TWA) exposures ranged from 16 to 101 milligrams per meter cubed of air (mg/m^3) with an arithmetic mean of 49 mg/m^3. The NIOSH recommended exposure limit (REL) is 100 mg/m^3 TWA. Mineral spirit exposures ranged from 16 to 43, with a mean of 33 mg/M^3. The NIOSH TWA REL exposure is 350 mg/M^3.

Sampling was conducted for a proprietary compound added to the coolants having acidic properties. However, no exposure levels were documented and the compound if present in the air would have been below 0.13 mg/m^3. No evaluation criteria applicable to this compound were found. Breathing zone asbestos exposures for the furnace workers ranged from non-detectable (ND) to 0.01 fibers per cubic centimeter (fibers/cc). The NIOSH REL limit is 0.1 fibers/cc TWA, the OSHA permissible exposure limit (PEL) is 2 fibers/cc. Bulk samples (2) of insulation lying loose in and around the annealing furnaces contained 3 to 5 % amosite asbestos and from less than 1 to about 3% chrysotile asbestos. A replacement refractory material in use between coils did not contain asbestos. Carbon monoxide exposures of furnace workers monitored were negligible, less than 5 parts per million (ppm). The

NIOSH REL is 35 ppm, the OSHA PEL is 50 ppm. Mineral oil was not in use in this facility's rolling mill.

NIOSH investigators did not identify any specific respiratory irritants during the course of this HHE. A potential overexposure to kerosene mist and the presence of friable asbestos-containing insulation were identified. However, these substances present potential health hazards other than respiratory irritation. Recommendations addressing local exhaust ventilation, personal protective equipment, and removal and control of asbestos-containing materials in the workplace are presented in Section VIII.

KEYWORDS: SIC 3353 (Aluminum Sheet, Plate, and Foil), rolling oils, coolant, kerosene, mineral spirits, asbestos, carbon monoxide.

II. INTRODUCTION

On August 21, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a Health Hazard Evaluation (HHE) from authorized representatives of Local 8573, United Steel Workers of America. The request concerned reports of respiratory illness among Local 8573's membership employed at the National Aluminum Rolling Division located in Salisbury, North Carolina. Some of the exposures of concern listed on the request were kerosene based rolling mill coolant mist, additives of the coolant, and asbestos liners in the annealing furnaces. Occupations of exposed employees were listed as including rolling mill operators and helpers and annealing furnace operators and helpers.

NIOSH investigators conducted two site visits: an initial survey including a walk-through November 27, 1984, and a follow-up industrial hygiene survey May 20-22, 1985. Interim report letters presenting significant findings from the May 1985 survey were sent out in July and October 1985. These reports served to inform management and labor of friable asbestos material confirmed to be present around the annealing furnaces and of high kerosene exposures at the No. 5 rolling mill.

The purpose of the follow-up survey was to identify and evaluate respiratory hazards present in the rolling mill area. This study was limited to the rolling mill and annealing furnace areas of the plant. During the walk-through survey a NIOSH physician interviewed mill workers concerning respiratory complaints, but was unable to identify any specific circumstances associated with these complaints.

III. BACKGROUND

A. Plant History, Product Lines, and Workforce

The Salisbury Rolling Mill began operations in late 1965 and is capable of rolling aluminum foil to gauges as light as 0.00025 and in widths up to 60 inches wide. A continuous cast unit enables this plant to produce aluminum foil and light gauge sheet directly from ingots and/or scrap aluminum. The foil produced at this plant is used for packaging, insulation, the electronic industry, cable sheathing, fin stock, and miscellaneous industrial uses. The facility currently operates five rolling mills and eleven annealing furnaces. Total employment at the plant is about 285 with 235 hourly workers.

B. Process Description

Cast coils are produced in the Casting Department from either ingots or aluminum scrap. These coils are sent to the Rolling Mill to be reduced to thinner gauge material. All coils initially pass through the breakdown mill, reducing the coil thickness to a gauge which can be fed into the remaining mill stands. Each mill stand operates independently of the others. A kerosene based coolant is used on the mills with each unit connected to a coolant filtration system. The coolant is continually replenished with new coolant and additives (fatty alcohols and acids) to maintain the system within defined operating parameters and replace coolant lost during aluminum gauge reduction. Each mill stand has a canopy hood located above the payoff (feed) and rewind ends to remove mists and vapors generated during the rolling process.

The coils of aluminum are placed in the annealing furnaces to impart flexibility, strength, workability, and remove oils and residues. The furnace interiors are maintained under an oxygen deficient atmosphere to prevent oxidation of the aluminum. The final annealing is completed after the foil is processed to the customers' final specifications, such as separating double sheets of foil, and trimming to the appropriate width and outside diameter of the final coil. The foil is then inspected for defects and packed for shipment.

A mineral spirit solvent is used both in the processing of certain foils and for equipment clean-up.

Approximately 52 workers are in the Mill Department, staffing four shifts.

IV. METHODS AND MATERIALS

The industrial hygiene component of the HHE involved personal exposure monitoring of workers with portable sampling pumps during the 7 a.m. to 3 p.m. work shifts May 21 and 22, 1985. Contaminant exposures evaluated were asbestos, a proprietary additive (fatty acid), kerosene, mineral spirits, and oil mist. Bulk samples of insulating material lying loose around two of the annealing furnaces and area long term detector tube samples for carbon monoxide were also collected. A replacement refractory material was also evaluated for asbestos content.

A. Asbestos

Personal asbestos exposures of annealing furnace operators and helpers were determined according to NIOSH Method 7400[1]. The 50 millimeter (mm) cowl extension was wrapped in foil prior to use of the cassettes and remained in place until the analysis. The sampling rate used was 2 liters per minute (Lpm) and the limit of detection for this sample set was 0.03 fibers per field or 1500 fibers per filter for the 25 mm filters. The A counting rules were applied to the samples.

B. Asbestos Bulk Samples

All samples were examined for homogeneity. Non-homogeneous samples were ground manually to insure homogeneity. Microscope slides were prepared from each sample using 1.55 refractive index liquid. The slides were then scanned for the presence of asbestos utilizing polarized light microscopy and dispersion staining techniques. A Leitz Dialux 20™ microscope equipped with a 16x objective and a 10x eyepiece was used for the analysis.

The percentage of asbestos was estimated by a microscopic examination of the sample. Asbestos forms identified as being present in the sample were confirmed with the appropriate refractive index liquids applying dispersion staining techniques. All samples were examined by two separate analysts. Results were averaged and reported in percent by volume.

C. Fatty Acid

Personal exposure samples of a proprietary coolant additive were collected using 37 mm polyvinyl chloride (PVC) filters at a sampling rate of about 1.2 Lpm over a full work shift. Each sample was extracted with 2 milliliters (mL) of methylene chloride for 30 minutes. The extracts were then analyzed by gas chromatography using a HP 5880 gas chromatograph (GC) equipped with a 30 meter DB-1 fused silica capillary column and a flame ionization detector. A bulk sample of the material was provided for preparation of standards.

An extraction efficiency study was performed to ensure that the fatty acid could be extracted. Under the conditions of the analysis, the limit of detection was 0.06 milligrams (mg) per sample.

D. Kerosenes and Mineral Spirits

Worker exposures to kerosene and mineral spirits were obtained using standard coconut shell charcoal tubes and low flow personal sampling pumps calibrated at a flow rate of 0.1 Lpm. Sample duration approximated the full workshift. Bulk samples of the two kerosenes and solvent in use on the rolling mills was submitted to the laboratory for use in standards preparation.

The front and back sections of the charcoal tube samples were separated and analyzed by gas chromatography according to NIOSH

P&CAM 127 (2) with the following modification:

Desorption Process:	30 minutes in 1.0 mL of carbon disulfide
Gas Chromatograph:	Hewlett-Packard Model 5711A equipped with a flame ionization detector
Column:	30 meter x 0.32mm fused silica capillary column coated internally with 1.0 micrometer (um) of DB-5
Oven Conditions:	Temperature program: 70° Celsius (C) (8 minutes) to 200°C (4 minutes) at 4°C per minute.

Quantitation was performed by summing the areas of the five or six major peaks of the standards prepared with each bulk sample and comparing these sums to those of the same peaks in the samples. Quantitation using the bulks in this manner was possible because the patterns of the samples matched the patterns of the bulks. The limit of detection was 0.1 mg per sample for both kerosene and mineral spirits.

E. Oil Mist - Bulk Coolant Evaluation by Gas Chromatography/Mass Spectroscopy

Personal exposure monitoring for oil mist was conducted using 37 mm PVC filters at a flow rate of 1.2 to 1.3 Lpm for a full workshift. There was some question as to whether a mineral oil analysis for oil mist would contribute any information of value since the coolant is kerosene based. The composition of the base coolant material was screened by gas chromatography and gas chromatography interfaced with a mass spectrometer in order to ascertain exactly what type of compounds were present. Information obtained from this determination of whether the base coolant had any mineral oil content or if primarily kerosene type naphthas were present determined how the exposure samples would be treated for analytical purposes.

Portions of each of the two bulk samples for the two base coolants were mixed with carbon disulfide and screened by a gas chromatograph equipped with a flame ionization detector. A 30-meter DB-1 fused silica capillary column (splitless mode) was used for all analyses. A qualitative standard containing all n-alkanes from C_6 to C_{19} (aliphatic hydrocarbons having six to 19 carbons in a straight chain) was also run at the same time. These bulk solutions were subsequently screened by gas chromatography coupled with mass spectroscopy.

Six field blanks were submitted along with the personal exposure samples for each type of analysis.

F. Carbon Monoxide

Carbon monoxide exposures of workers assigned to the annealing furnaces were evaluated using low flow sampling pumps and long-term direct reading indicator tubes. Several area samples were also collected in the areas around and above the annealing furnaces.

V. EVALUATION CRITERIA AND TOXICITY SUMMARIES

A. Environmental Criteria

As a guide to the evaluation of the 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 criteria. 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 any agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) The American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) The U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV'S are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's 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 recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In reviewing the exposure levels and the recommendations for reducing those levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 to meet those levels specified by OSHA standards.

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.

Evaluation Criteria used in this report are present in Table 1 and the following Toxicity Discussion.

B. Toxicity Discussion

1. Asbestos

Asbestos causes asbestosis, cancer of the lungs and digestive tract, and mesothelioma. Asbestosis is a lung disorder characterized by a diffuse interstitial fibrosis, at times including pleural changes of fibrosis and calcification. A restriction in pulmonary function occurs. Symptoms accompanying clinical changes may include fine rales, finger clubbing, dyspnea, dry cough, and cyanosis. The onset of asbestosis probably depends upon the asbestos dust concentration, the fiber morphology and the length of exposure. Usually the pneumoconiosis becomes evident 20 to 40 years after the first exposure to asbestos. Asbestosis is progressive even after exposures have stopped (5).

Bronchogenic carcinoma and mesothelioma of the pleura and peritoneum are causally associated with asbestos exposures; excesses of cancer of the stomach, colon, and rectum have also been observed. Neoplasms, such as mesothelioma, may occur without radiologic evidence of asbestosis at exposure levels lower than those required for prevention of radiologically evident asbestosis. Mesotheliomia can occur after a short, intensive exposure. Information is insufficient at this time to set an exposure standard (other than zero) which could assure prevention of mesothelioma in all workers, since the disease may occur following a very limited exposure 20 to 30 years earlier (5).

Cigarette smoking is strongly implicated as a cocarcinogen among asbestos workers. The incidence of bronchogenic carcinoma among non-smoking asbestos workers is not significantly greater than that of non-asbestos workers, while asbestos workers who smoke have a much higher incidence (5).

2. <u>Kerosene</u>

A report of acute human exposure to deodorized kerosene at a level of 140 mg/m^3 (20 parts per million or ppm) indicated that this compound has relatively low toxicity (6). No expression of discomfort or irritation during or after a 15 minute inhalation period was reported by the subjects, however 50 percent developed olfactory fatigue. Concern was expressed that the toxicity of regular kerosene may be greater due to a higher aromatic content (5-20%) than is found in deodorized kerosene (3.9%). Another study showed that aerosol exposure to unpurified kerosene was more toxic, but there was no indication that any grade of kerosene causes toxicity at concentrations of 100 mg/m^3 or below. Although short-term exposures to aerosols in this latter study (8 hours per day for 1 day or 6 hours per day for 4 days) did not produce signs of systemic toxicity; aerosol exposure to unpurified kerosene at 500 to 12000 mg/m^3 for two hours per day for two to four weeks caused leukocytosis, tracheitis, bronchitis, and pneumonia (7). Dermal irritation did occur as an effect of the short-term exposure study. Exposure to kerosene in aerosol form appears to be of greater concern due to the possible accumulation of kerosene in the lungs resulting in pneumonitis, thus exposure to the aerosol form should be minimized (7).

The NIOSH REL of 100 mg/m^3 reflects the concern that since kerosene is less volatile than other solvents, at any specified concentration more of the material is likely to be present in aerosol form, especially as airborne concentrations exceed this level.

Skin irritation, as previously mentioned, has been associated with kerosene exposures and possibly some bone marrow depression, although this was probably from benzene absorption after dermal exposure. Care is advised in preventing dermal exposure. Thirty minutes of dermal kerosene exposure has caused changes in skin structure. Burning sensations have developed during the first hour of kerosene exposure, erythema (redness) by the second hour, and blister formation by the 12th hour. Solutions containing 40% of kerosene have been shown to be innocuous to human skin but dermatitis began to appear in increasingly larger numbers of volunteers exposed to solutions with kerosene levels of 55, 70, and 85% (7). Naphthenic-type kerosene (kerosenes having saturated ring structures or cycloparaffins) have greater skin-irritating potential than paraffinic-type (straight chain aliphatic hydrocarbons) kerosene. Kerosene has also been shown to augment the toxicity of a skin-sensitizing agent (7).

3. Mineral Spirits

Mineral spirits and stoddard solvent exhibit a large degree of similarity concerning their chemical composition. The boiling ranges (150-200°C for mineral spirits, 160-210 for stoddard solvent) and chemical composition are similar.

Mineral spirits at concentrations of 2,500 mg/m^3 or greater have been shown to cause nausea and vertigo in humans. Concentrations of 625 to 2,500 mg/m^3 for periods up to two hours had no effect on performance tests, such as perceptual speed, reaction time, short-term memory, numerical ability, and manual dexterity (7).

Animal studies did not indicate any consistent pattern of hematologic (blood or blood-forming tissues) relationships or any remarkable gross changes except for lung irritation. Deaths were not seen at any concentration in rats, rabbits, dogs, or monkeys; however, some guinea pigs exposed at concentrations at or in excess of 363 mg/m^3 died. The lung irritation observed was seen mainly in the animals exposed at 1,353 mg/m^3 for 8 hours a day, five days a week, for six weeks (7).

Mineral spirits have been shown to cause dermatitis, and stoddard solvents have been recognized as being capable of causing skin irritation and possibly aplastic anemia after dermal exposure. Nevertheless, extensive dermal exposure to mineral spirits should be avoided if for no other reason than the ability of mineral spirits to defat the skin and cause dermatitis.

The action levels (exposure levels at which corrective measures should begin to be implemented) for mineral spirits and kerosene equal the exposure criteria for these solvents because of their lower volatility and a lower likelihood of toxicity at the REL. Note that these action levels have been chosen on the basis of professional judgement rather than on specific quantitative data delineating non-hazardous concentrations from those at which a definite respiratory hazard exists[7]. Non-respiratory effects of exposure have been included in this consideration.

VI. RESULTS

A. Asbestos

Personal exposure monitoring of the two workers in the Annealing Furnance area indicated that exposures to airborne asbestos fibers May 21 and 22, 1985, were well below the NIOSH REL of 0.1 fiber/cc. Table II presents the exposure data which ranged from below detectable levels up to 0.01 fibers/cc.

Table III presents the results of the bulk asbestos determination analyses performed on insulation material lying loose in and around the annealing furnaces. Asbestos was identified as being present in both samples (up to 5%) collected from floor surfaces around the furnaces. These two samples were apparently insulation that had deteriorated and fallen down from the interior of the furnace walls. The insulation was lying loose around the interior and exterior of the furnaces.

A bulk sample of refractory fiber used when loading coils of aluminum to prevent damage to the coils did not contain any detectable asbestos fibers.

B. Fatty Acid

Personal exposure monitoring for a fatty acid added to the base coolant did not indicate any detectable exposures. Sampling was conducted for this compound as a potential irritant, however environmental concentrations were all below an environmental limit of detection of 0.13 mg/m^3.

C. Kerosene and Mineral Spirits

All but one of the 14 personal exposure samples collected for total kerosene exposure were below the NIOSH REL of 100 mg/m^3 over an 8 -to 10-hour workshift. The two kerosenes in use were different enough in composition, concerning the primary carbon chain lengths present in each kerosene, to permit analysis for both in each sample. The reconstructed ion chromatograms for the two kerosenes obtained from the GC/MS analyses are presented in Figures I and II. Both kerosenes are composed primarily of straight chain aliphatic hydrocarbons (paraffinic-type).

Worker exposures to total kerosene (summing the exposures to kerosenes A and B) had an arithmetic mean of 48.7 mg/m^3 for an eight hour workshift. The exposures ranged from 15.9 to 100.8 mg/m^3 and the median exposure (the value at which 50% of the exposures were higher and 50% were lower) was 45.4 mg/m^3.

Table IV presents the exposure data for both kerosene and mineral spirits.

The mean (arithmetic) mineral spirit exposure over a full workshift was 32.9 mg/m^3, with a range of 16.0 to 42.6 mg/m^3 and a median value of 38.9 mg/m^3. The NIOSH REL is 350 mg/m^3. A brief description of the different job titles of exposed workers is presented in Table V.

D. Oil Mist

Analyses of samples collected for oil mist exposures were not undertaken subsequent to the bulk coolant analysis. The bulk coolant analysis confirmed that no mineral oil was present in the coolant, and therefore the mists present in the rolling mill area would be composed largely of kerosene and not mineral oil. The sampling media used (polyvinyl chloride filters) was unsuited for kerosene analyses. In addition, sorbent tube samples had already been collected separately to assess kerosene exposures.

E. Carbon Monoxide

Full-shift measurements of personal exposures to carbon monoxide of the two furnace crew workers during the survey were below 5 ppm both days. Area samples collected above the front of furnace 10 (May 21) and alongside furnace 22 (May 21 and 22) were also below 5 ppm of carbon monoxide. One sample placed above furnace 27, midway along the side, produced a carbon monoxide time weighted average (TWA) of 38 ppm. Furnaces at which area samples were obtained were using the "inert" gas during the annealing process. The NIOSH TWA REL for carbon monoxide over an 8- to 10-hour workshift is 35 ppm.

VII. DISCUSSION AND CONCLUSIONS

A potential for worker exposure to airborne asbestos fibers exists in the annealing furnace area. It is associated with the deterioration of asbestos-containing insulation in the furnace walls. Although no breathing zone overexposures to asbestos were documented by the NIOSH investigators, workers voiced concerns regarding potential exposures to this deteriorating insulation as asbestos may become airborne through further deterioration of the insulation and entrained by connective air currents as the furnaces are opened. Poor or inappropriate housekeeping and maintenance activities also provide potential for worker exposure to asbestos fibers. Activity levels in the annealing furnace area were low during this investigation and no clean-up of fallen insulation was undertaken during the periods exposure monitoring was conducted. The investigators consider short-term high level exposures to asbestos fibers on a sporadic basis more likely to occur than elevated full shift exposures to airborne asbestos concentrations.

Additionally, since the areas occupied by the annealing furnaces are not physically separated from the rest of the plant, friable asbestos-containing material released around or inside of the furnaces could, if released in sufficient quantity, contaminate surrounding plant areas. Workers also reported that when the furnaces are opened after completion of the annealing process, material from inside the furnace is visibly carried out into the plant with the convective air currents. This was not observed to occur for the furnaces opened on the shifts during which sampling was being conducted.

Exposures to the fatty acid added to the coolant are negligible and the compound itself is considered to have low toxicity. The compounds used by the company in their coolants are those permitted by the Food and Drug Administration in the manufacture of metallic articles that contact food. Further evaluation of this proprietary additive is not considered necessary based on the findings of this survey, the manner in which the material is used, and the negative sampling results.

Kerosene and mineral spirit exposures were respectively, with one exception, all below the applicable NIOSH evaluation criteria of 100 and 350 mg/m^3. Mill Operator B on the No. 5 Mill had a kerosene exposure May 22 equal to the NIOSH REL. The majority of his exposure, was to kerosene A, the base coolant in use on Mill No. 5. The average contribution of each of the two kerosenes to each personal exposure obtained during the survey, was 92% from kerosene A, used on Mills 2, 3, 5 and 8% from kerosene B, used as a base coolant on Mills 1 and 4. Mineral spirit usage on the mills varied with the product being run and depended or whether the mill was equipped for solvent application during processing.

Local exhaust ventilation was present on all of the mills, however the efficiency of these systems in capturing mists generated during the rolling process was observed to vary considerably. Factors influencing mist production can include mill speed, the amount of reduction in gauge made during the pass through the mill, and the number of "tear outs" or flaws in the coil requiring removal from the mill. Mists were observed escaping from the hoods (slot and canopy type) due to their distance from the point of mist generation and the use of pedestal fans to direct the mist away from operator work stations and into the hoods. Coils of aluminum placed onto the mills were at room temperature whereas coils removed from the mills were hot with some subsequent release of visible vapors after the coil was removed from the mill.

The type of kerosene in use on the mills is paraffinic in nature, which has less skin irritating potential than naphthenic type kerosenes(7).

Mineral oil mist was not evaluated, since mineral oil was not present as a constituent of the rolling mill coolants nor was mineral oil in use elsewhere in the department.

Carbon monoxide exposures of the annealing furnace operators were negligible. Area samples obtained during the survey were also low except for one above an annealing furnace. A worker required to check equipment or spend a limited period of time above the furnace would, based on the limited sampling of this survey, not be likely to have an overexposure to carbon monoxide. A worker required to spend a full shift above the furnace, which is operating with inert gas may be overexposed if he/she works at a location such as above Furnace 27 where the measured TWA was 38 ppm.

In summary, this investigation did not identify any specific source of respiratory irrition in the rolling mill department, although several exposures to kerosene approaching the NIOSH REL were documented. Additionally, non-respiratory effects such as those resulting from skin or eye contact support a recommendation that appropriate work practices and protective measures (such as engineering controls, housekeeping, and personal protective equipment) be required regardless of the air concentration.

No respiratory hazard from asbestos exposure was identified by the breathing zone air samples collected during the survey, however a potential for exposure associated with deteriorating furnace insulation necessitates implementation of corrective measures.

No hazard associated with the acidic additive to the coolant was identified. Significant mineral oil mist exposures are not a possibility with the coolant system currently in use.

VIII. RECOMMENDATIONS

1. The existing local exhaust systems should be inspected and evaluated to insure optimum performance, as well as to determine the system's effectiveness and limitations in removing vapors and mists generated during the operation of the rolling mills.

2. The necessity for using large pedestal fans should be assessed and alternatives explored since their use creates significant cross drafts which may negate the effectiveness of the exhaust systems present on the mills.

3. The addition of flanges, strip curtains, or moveable enclosures to the canopy and slot hoods located at the top of each mill is suggested to enhance the effectiveness of the existing exhaust ventilation systems in capturing coolant mist.

4. The presence of loose asbestos containing insulation in and around the annealing furnaces necessitates the implementation of housekeeping measures in accord with the OSHA General Industry Standard for asbestos, 29 CFR 1910.1001, paragraph h-housekeeping[3]. Asbestos insulated structures on the furnaces should be sealed to prevent the further release of material. Removal and replacement of asbestos insulation with non-asbestos materials from locations where sealing is not possible is also recommended. A maintenance program is advised to ensure that the integrity of asbestos enclosures is maintained and that equipment containing asbestos insulation is identified so that proper precautions may be taken when work on such equipment is required.

5. Workers should avoid using gloves or wearing work clothes and personal protective equipment that have become wetted with kerosene, since this contributes to prolonged skin contact resulting in dermal irritation and increases the likelihood of dermatitis.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 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 the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. United Steel Workers, Local 8573
2. National Aluminum, Salisbury, North Carolina
3. International United Steel Workers of America
4. NIOSH, Region IV
5. OSHA, Region IV

For the purpose of notifying the 52 affected employees, 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

Evaluation Criteria and Health Effects Summary

National Aluminum
Salisbury, North Carolina
HETA 84-483

Contaminant	Recommended Exposure Limit mg/m³ (ppm)[1]	Source[2]	OSHA[3] Standard mg/m³ (ppm)	Health Effects: Symptoms	Health Effects: Target Organs	Health Effects: Reference
Asbestos	0.1 fiber/cc (↑ 5um length)	NIOSH	2 fibers/cc (↑ 5um length)	Restricted pulmonary function; shortness of breath, dry cough, finger clubbing	Lungs, digestive tract (human carcinogen)	4,5
Carbon Monoxide	40(35)	NIOSH	55(50)	Headache, tachypnea, nausea, weakness, dizziness, confusion, hallucinations; cyanosis; depression; angina; syncope; frostbite	Cardiovascular system lungs, blood, central nervous system.	6
Kerosene (C_9-C_{16})	100	NIOSH	-	Skin irritation, dermatitis, inhalation of high concentrations may cause headache, nausea, confusion, drowsiness, and coma; extensive lung damage if aspirated	Skin, lungs	7
Mineral Spirits	350	NIOSH	-	Nausea, vertigo; skin irritation, dermatitis	Skin	7

1. Exposure limits are given in milligrams per cubic meter (mg/m³) and parts per million (ppm) where applicable. Volume per volume (ppm) values are not given for kerosene or mineral spirits since both are of variable composition, not having a specific molecular formula or weight. Asbestos limits are given in fibers per cubic centimeter (cc) of air for fibers greater than (↑) 5 micrometers (um) in length.

2. NIOSH: National Institute for Occupational Safety and Health. See references 4, 6, and 7.

3. OSHA: Occupational Safety and Health Administration, reference 3.

Table II

Airborne Asbestos Exposures of Annealing Furnace Workers

National Aluminum
Salisbury, North Carolina
HETA 84-483

May 21-22, 1985

Sample Description*				
Date	Job Title	Sample Volume L	Sample Duration min	Asbestos Fibers per cubic centimeter**
5/21/85	Furnace Operator	970	485	Trace
5/21/85	Furnace Utility	954	477	Trace
5/22/85	Furnace Operator	994	497	ND
5/22/85	Furnace Utility	948	494	Trace
Limit of Quantitation: NIOSH Method 7400 (Reference 1)				38,500 fibers/filter or 0.04 fibers/cc
	Evaluation Criteria: OSHA			2 fibers/cc, >5 um in length
	NIOSH			0.1 fibers/cc, >5 um in length

* Sample volume is given in liters (L) and duration in minutes (min).
** Trace denotes that asbestos fibers were identified as present in the sample, but at a concentration below the analytical limit of quantitation (LOQ) which approximates an airborne TWA exposure level of less than 0.04 fibers per cubic centimeter (cc).
ND denotes no asbestos fibers were detected in the sample.

TABLE III

Bulk Insulation Asbestos Analysis

National Aluminum
Salisbury, North Carolina
HETA 85-483

May 1985

Sample Identity	Type of Asbestos Identified	Approx. Percent Present *
Loose insulation below door of furnace No. 1	Amosite Chrysotile	5 <1
Loose insluation along wall on floor, from inside furnace No. 2	Amosite Chrysotile	3-5 2-3
Refractory fiber used under/between coils during annealing (Mfr: Johns Manville)	None detected	-

* The percentage of fibrous asbestos is estimated by a microscopic examination of the sample. Results are an average and reported in percent by volume. See Section IV Methods and Materials.

TABLE IV

Worker Exposures to Kerosene and Mineral Spirits in the Rolling Mill Area

National Aluminum
HETA 84-483

May 21-22, 1985

Sample Description					Kerosene Exposures in mg/m³ [1]			Mineral Spirits mg/m³ [1]
Date	Job Title	Work Station	Sample Volume Liters	Sample Duration minutes	Kerosene A	Kerosene B	Total	
5/21	Mill Operator A	Mill 1-rewind	44.7	453	22.4	6.7	29.1	-
5/22	Mill Operator A	Mill 1-rewind	47.5	437	42.1	4.2	46.3	-
5/21	Mills Utility	Mill 1	50.2	468	15.9	ND	15.9	-
5/22	Mills Utility	Mill 1	47.3	445	21.1	2.1	23.3	-
5/21	Mills Utility	Mills 2&3	49.0	490	61.2	ND	61.2	-
5/22	Mills Utility	Mills 2&3	55.3	489	54.3	1.8	56.1	-
5/21	Mill Operator A	Mill 3-rewind	48.8	485	61.5	2.0	63.5	41.0
5/22	Mill Operator A	Mill 3-rewind	46.9	479	85.3	2.1	87.4	42.6
5/21	Mills Utility	Mill 4	46.9	479	14.9	2.1	17.0	-
5/22	Mills Utility	Mill 4	46.5	493	21.5	4.3	25.8	-
5/21	Mill Operator A	Mill 5-rewind	49.6	504	40.3	4.0	44.4	20.2
5/22	Mill Operator A	Mill 5-rewind	50.3	503	79.5	6.0	85.5	39.8
5/21	Mill Operator B	Mill 5-payoff	50.0	502	20.0	4.0	24.0	16.0
5/22	Mill Operator B	Mill 5-payoff	52.6	511	95.1	5.7	100.8	38.0
Analytical Limit of Detection in milligrams per sample:					0.1	0.1	NA[2]	0.1
Evaluation Criteria: NIOSH							100	350

1. Exposures are given in milligrams per meter cubed of air (mg/m^3). The two kerosenes in use were different enough to permit quantitation of each. See Figures I and II.

2. NA = not applicable. The concentrations of the two kerosenes are added together for comparison to the evaluation criteria. These total values were not obtained from a separate analysis.

TABLE 1

Job Descriptions of Workers Monitored for Exposures to Workplace Contaminants

National Aluminum
Salisbury, North Carolina
HETA 84-483

Job Title	Summary Description
Rolling Mill Operator "A"	Sets up and operates sheet mill to cold roll variety of aluminum coilstock to specified thickness following generally presecribed method and procedures. Plans operational sequence. Sets up new coils on mill. Monitors rolling mill operation both manually and automatically.
Rolling Mill Operator "B"	Performs all required duties to assist Rolling Mill Operator "A". Prepares metal for rolling. Loads coils and feeds into mill. Watches for quality problems during rolling of coils. Material handling for loading and unloading of mill. Must be qualified to set up knives and other working parts of mills assigned.
Utilityman-Mill	Performs all required material handling duties for the mill department including the movement of materials, supplies, and equipment. Handles material in the mill storage area, using fork lift trucks, overhead hoist and other material handling equipment. Services fork lift and other material handling equipment as required or directed. Helps on mills when needed to start up.
Anneal Furnace Operator	Operates a group of gas fired, atmospherically controlled, annealing furnaces to anneal a variety of coils of aluminum stock following presecribed methods and procedures. Also operates and helps maintain four generators. Prepares coils of foil for annealing, loading and unloading furnaces, monitoring annealing operation, and maintaining equipment as required.
Utilityman-Finishing (Furnance Utility)	Performs all required material handling duties including moving coils of metal anneal racks, and scrap to areas within the plant.

Source: Company job rating specification sheets

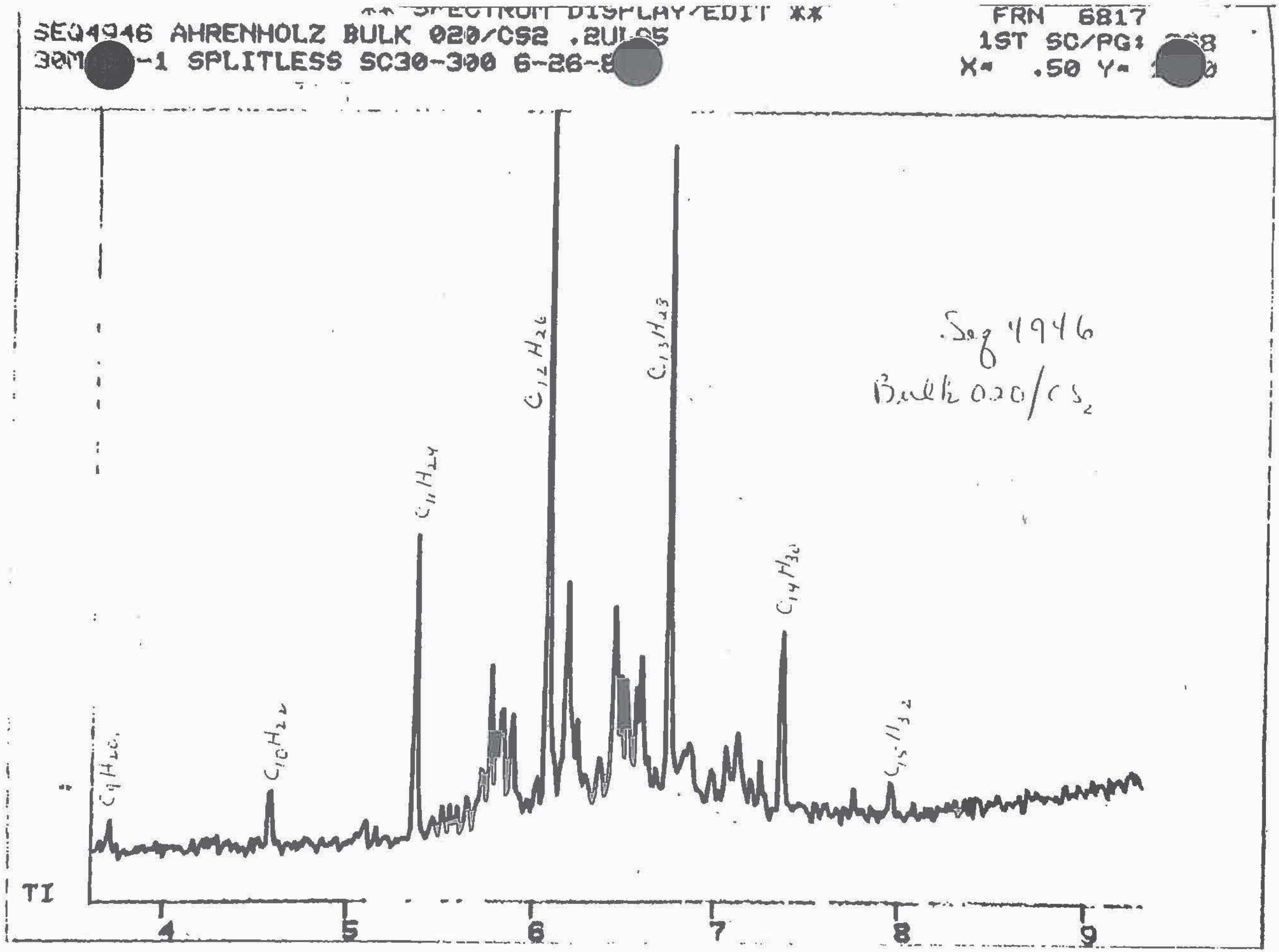

FIGURE I

Coolant Ion Chromatogram for Kerosene A

National Aluminum

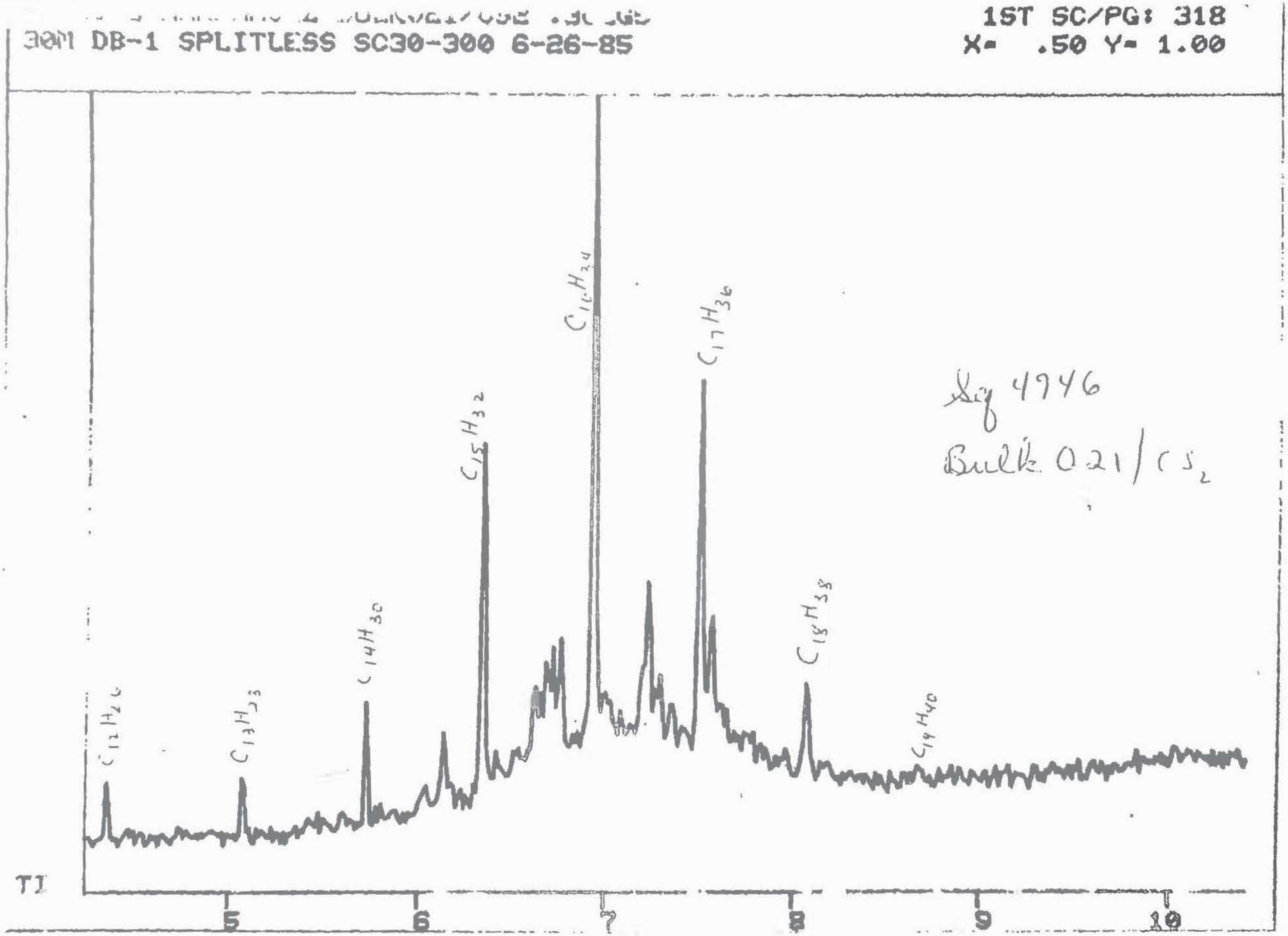

FIGURE II
Coolant Ion Chromatogram for Kerosene B
National Aluminum
Salisbury, North Carolina