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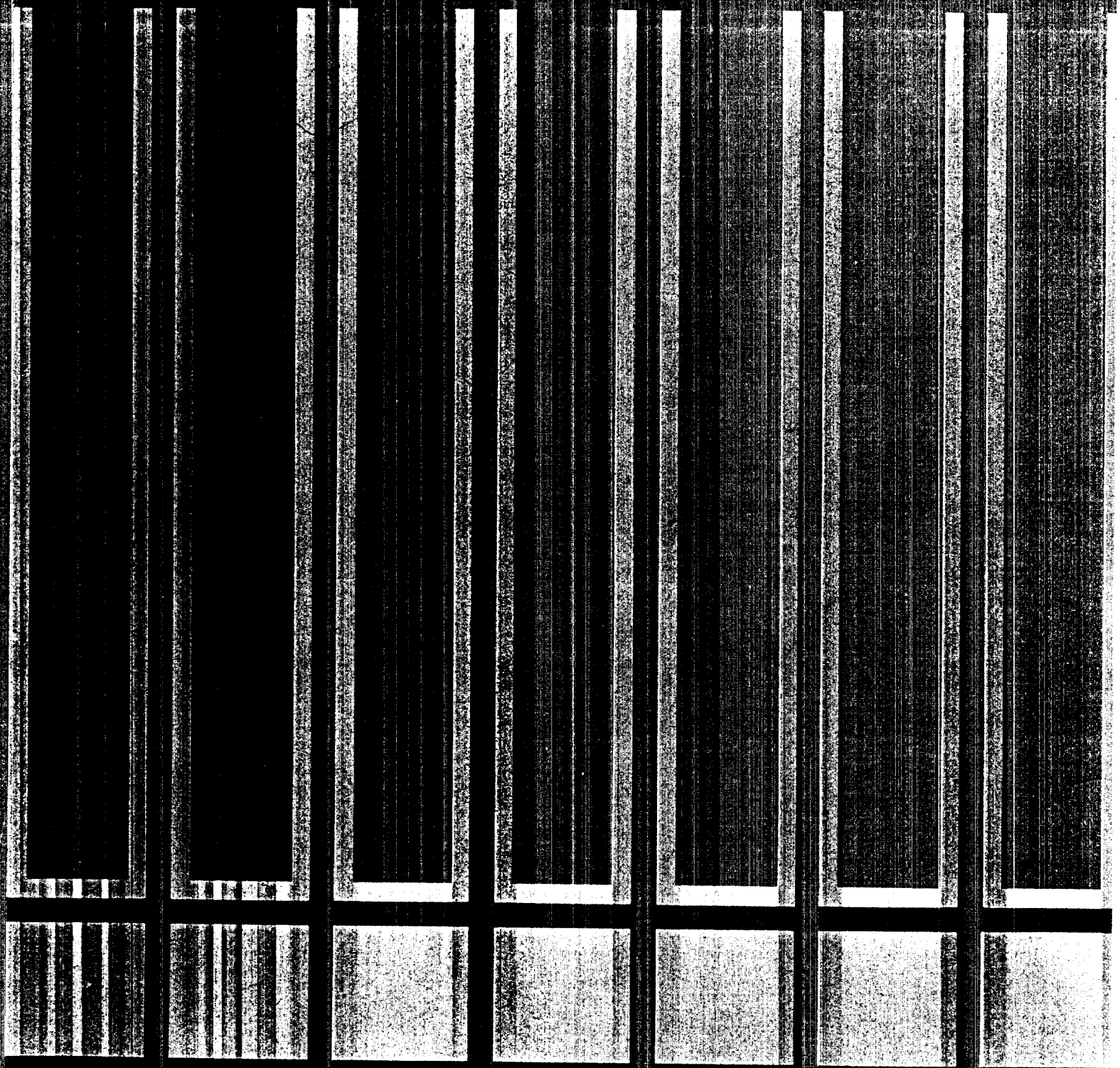
ACETYLENE



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service Center for Disease Control
National Institute for Occupational Safety and Health

criteria for a recommended standard....

OCCUPATIONAL EXPOSURE TO ACETYLENE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
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National Institute for Occupational Safety and Health
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PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on acetylene by members of my staff and the valuable constructive comments by the Review Consultants on Acetylene, by the ad hoc committees of the American Academy of Industrial Hygiene and the American Medical Association, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine. The NIOSH recommendations for standards are not necessarily a consensus of all the consultants and professional societies

that reviewed this criteria document on acetylene. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

John F. Finklea, M.D.
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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and the recommended standard for acetylene. The Division review staff for this document consisted of Vernon E. Rose, M.S., and Paul Caplan, M.P.H.

Stanford Research Institute developed the basic information for consideration by NIOSH staff and consultants under contract CDC-99-74-31. Donald M. Valerino, Ph.D., had NIOSH program responsibility and served as criteria manager.

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CRITERIA DOCUMENT:
RECOMMENDATIONS FOR AN OCCUPATIONAL
EXPOSURE STANDARD FOR ACETYLENE

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I. RECOMMENDATIONS FOR AN ACETYLENE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to acetylene in the workplace be controlled by compliance with the following sections. The standard is designed to protect the health and safety of workers for up to a 10-hour work shift, 40-hour workweek, over a working lifetime. Compliance with the standard should therefore prevent adverse effects produced by exposure to acetylene. The standard is measurable by techniques that are valid, reproducible, and available to industry and governmental agencies; there is sufficient technology to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision as necessary.

Arsine, an inorganic compound of arsenic, in variable small amounts is often present in commercially available acetylene as a contaminant. Because arsenic and its inorganic compounds have been implicated in the production of malignancies of the lung, NIOSH recommends that certain precautions be taken to assure that exposure of employees to arsenic is minimized. In order that employees are informed of the hazards of the contaminants in commercially available acetylene, which may be, in addition to arsine, phosphine, hydrogen sulfide, methylacetylene, and others, it is recommended that commercially available acetylene be chemically analyzed qualitatively and quantitatively to the extent necessary to allow an evaluation of the total toxic hazard due to the presence of acetylene in

the workplace. It is imperative that employees be informed of the results of this analysis and be provided with an interpretation of these results with respect to possible adverse effects on their health. The Material Safety Data Sheet (MSDS) must contain the results of the aforementioned analysis and provide an indication of the total hazard to health caused by commercially available acetylene.

These criteria and recommended standard apply to exposure of workers to acetylene (C_2H_2), also known as ethine, ethyne, and Narcylene. "Occupational exposure to acetylene" is defined as exposure to airborne acetylene at concentrations greater than the environmental limit. Exposure at lower environmental concentrations will not require adherence to the following sections of Chapter I with the exception of Sections 3, 4(a), 5, 6, 7, and 8. If exposure to other chemicals also occurs, as would be the case with various commercial grades of acetylene (which, depending on the source, may contain phosphine, arsine, hydrogen sulfide, methyl acetylene, or other contaminants), provisions of any applicable standard for these chemicals shall also be followed.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to airborne acetylene shall be controlled so that no employees will be exposed to acetylene at a concentration in excess of 2,500 ppm (2,662 mg/cu m of air).

(b) Sampling, Collection, and Analysis

Procedures for collection and analysis of environmental samples shall be as provided in Appendices I and II, or by any methods shown to be at

least equivalent in accuracy, precision, and sensitivity to the methods specified.

Section 2 - Medical

(a) Proper medical care shall be available to all employees affected by exposure to acetylene in emergency situations.

(b) Based on the principles of good occupational health practice, the employer should provide a preplacement medical examination, including medical history, and periodic physical examinations to employees who may be occupationally exposed to acetylene.

Section 3 - Labeling and Posting

(a) Labeling

Containers of acetylene shall be marked as required by the US Department of Transportation. These markings shall be kept in a readable condition. In addition, the following label shall be affixed to all containers:

ACETYLENE

DANGER!

FLAMMABLE AND EXPLOSIVE

Keep away from heat, flame, and sparks.
Close valve when not in use.

Either this label shall include a statement of qualitative and quantitative

analyses of the contents of the container (including, as a minimum, the relative amounts of phosphine, arsine, and hydrogen sulfide), must use other effective means to convey to employees the results of these analyses and an appropriate interpretation of these results with respect to the possible adverse effects on their health.

Labels for portable compressed-gas containers shall include a statement requiring their use in an upright position only. Wherever possible, these labels shall be located at the valve end and not on the cylindrical part of the container body. Lettering on each container label should be of sufficient size to be readily visible.

(b) Posting

Areas where acetylene is present shall be posted with the following sign:

ACETYLENE

DANGER! NO SMOKING

FLAMMABLE AND EXPLOSIVE GAS

In areas where calcium carbide is stored or used for acetylene generation, the following sing shall be posted:

CALCIUM CARBIDE

DANGER! NO SMOKING

DO NOT USE WATER OR FOAM ON FIRES

This warning sign shall be printed both in English and in the predominant language of non-English-reading workers. Employees unable to read posted warnings and labels and those unfamiliar with English or with the predominant non-English language shall receive periodic training sufficient to ensure their understanding of the contents of the label and poster specified in this section and to provide a continuing reminder of these contents.

Section 4 - Personal Protective Clothing and Equipment

(a) Protective Clothing

Individuals handling acetylene cylinders shall wear leather-type gloves and safety shoes. For welding or cutting operations, leather vests and welding sleeves are recommended, together with fiber-frame instead of metal-frame spectacles. Metal belt buckles and metal buttons that could become heated and cause burns should be avoided. Proper protective clothing shall be worn when dealing with any acetylene fire.

(b) Respiratory Protection

The use of respirators is not indicated because engineering controls or work practices, including those designed for welding or cutting operations, shall be used to maintain acetylene concentrations below the prescribed limits. This control equipment shall be sparkproof, explosion-proof, and electrically grounded. However, where the potential exists for the occurrence of a life-threatening emergency situation, emergency respiratory equipment shall be available.

Section 5 - Informing Employees of Hazards from Acetylene

(a) All employees shall be informed, at the beginning of their employment or assignment to an area where acetylene is used, stored, produced, or handled, of the hazards, appropriate emergency procedures, and proper conditions for safe use of acetylene and precautions to minimize exposure. All employees shall be informed, in addition, of the results of the chemical analyses of contaminants in acetylene to which they may be exposed, in accordance with Section 3(a) of this recommended standard. Each employee shall be instructed as to the availability of such information, which shall be kept on file. Information kept on file shall include that prescribed in paragraph (b) below and shall be accessible to the worker at each place of employment where acetylene is involved in unit processes and operations.

(b) Information as specified in Appendix III shall be recorded on the US Department of Labor Form OSHA-20, "Material Safety Data Sheet" (MSDS), or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor. In addition to the information specified in Appendix III, the MSDS must include the results of chemical analyses, both qualitative and quantitative, performed on commercially available acetylene, as well as an indication of the total toxic hazard of the material.

Section 6 - Work Practices

(a) Emergency Procedures

For all work areas in which there is a reasonable potential for emergencies, procedures as specified below, as well as any other procedures

appropriate for a specific operation or process, shall be formulated in advance, and employees shall be instructed in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for necessary transportation of injured workers.

(2) Firefighting procedures shall be established and implemented. These shall include procedures for emergencies arising from acetylene production, the use of acetylene in cylinders, or the transmission of acetylene by hose or pipeline. Fire protection equipment shall be conspicuously identified and located so as to be readily visible and accessible in an emergency.

(A) Acetylene fires arising from wet calcium carbide inside a building shall be extinguished by using dry-powder extinguishers or carbon dioxide. No water or water-based foams shall be used in such situations. Care must be taken to ensure that extinguishing the fire will not increase the hazard of explosion or lack of oxygen by allowing acetylene to accumulate in an unventilated area.

(B) The handling of acetylene cylinders in fire situations shall be in accordance with the Compressed Gas Association Safety Bulletin SB-4.

(3) Employees not essential to emergency operations shall be evacuated from exposure areas during emergencies.

(4) Personnel properly trained in the procedures and adequately protected against the attendant hazards shall shut off, isolate, and immediately repair the leaking sources of acetylene.

(b) Suitable engineering controls designed to limit exposure to acetylene to that prescribed in subsection (a) of Section 1 shall be utilized where appropriate and feasible. In addition, such controls shall be designed to limit fire and explosion hazards associated with acetylene.

Procedures for the handling, use, and storage of acetylene cylinders shall be in compliance with the present federal standard 29 CFR 1910.102(a) which is Compressed Gas Association pamphlet G-1. It is recommended that Compressed Gas Association pamphlet P-1 also be used for such procedures since additional information is contained in this publication. The use of acetylene cylinders in welding or cutting processes shall be in compliance with 29 CFR 1910.252. In addition, only acetylene cylinders which are suitably protected from any contact with hot metal slag or sparks shall be used in any welding or cutting operations.

Ventilation systems shall be designed to prevent the accumulation or recirculation of acetylene in the workplace. Exhaust ventilation systems discharging to outside air must conform with applicable local, state, and federal pollution regulations. To ensure maximum effectiveness, ventilation systems should be subject to regular preventive maintenance and cleaning and to periodic measurement of airflow.

(c) Acetylene containers shall have the valve closed and any regulator purged when not in use. All such containers shall be made from suitable materials and shall be protected from heat, corrosion, mechanical damage, and sources of ignition. Portable acetylene containers shall be used only while in a vertical position. These containers should also be stored in a vertical position. Containers that are not stored vertically shall be placed in a vertical position for at least 30 minutes before use.

(d) Because of the hazards associated with the combination of acetylene with certain other chemicals, unintentional contact between acetylene and the following substances shall be strictly prohibited: fluorine, chlorine, bromine, iodine, potassium, or cobalt; copper, silver, mercury, or any salts of these metals; or hydrides of sodium, cesium, or rubidium.

(e) All major equipment and piping employed in acetylene operations shall be electrically continuous and bonded to a grounding electrode in accordance with 29 CFR 1910.308 and 29 CFR 1910.309.

(f) Vessel Entry

(1) Entry into confined spaces, such as tanks, hoppers, and process vessels which have contained acetylene, or in which acetylene is used or combusted, shall be controlled by a permit system. Permits shall be signed by an authorized representative of the employer, certifying that preparation of the confined space, precautionary measures, and personal protective equipment are adequate, and that prescribed procedures will be followed.

(2) Confined spaces which have contained acetylene or in which acetylene combustion has occurred shall be inspected and tested for oxygen deficiency, as well as for the concentration of acetylene or other contaminants, especially phosphine, arsine, and hydrogen sulfide. Other standards have been developed for these contaminants and are listed in CFR 1910.1000. The space shall be thoroughly ventilated, cleaned, neutralized, and washed, as necessary, prior to entry.

(3) Inadvertent entry of acetylene into the confined space while work is in progress shall be prevented. Acetylene supply lines shall

be disconnected and blocked off.

(4) Confined spaces shall be ventilated while work is in progress to keep the acetylene concentration and concentrations of combustible byproducts below acceptable limits and to prevent oxygen deficiency.

(5) Individuals entering confined spaces where they may be exposed to acetylene shall be equipped with a lifeline tended by another worker outside the space.

Section 7 - Sanitation Practices

Smoking, introducing any source of ignition, or causing any form of ignition shall be prohibited in areas where acetylene is produced, stored, handled, or used. This prohibition shall not apply to deliberate introduction of ignition sources used in routine procedures, such as the lighting of a torch for welding or the burning of acetylene for illumination purposes.

Section 8 - Monitoring and Recordkeeping Requirements

Where workers may be occupationally exposed to acetylene, industrial hygiene surveys to evaluate exposure conditions shall be conducted within 6 months of the promulgation of this recommended standard, or within 30 days after installation of a new process or process change. Records of these surveys shall be maintained.

(a) If it is determined that acetylene concentrations are greater than the recommended environmental limit, then a program of personal

monitoring shall be instituted to identify and measure, or permit calculation of, the exposure.

(1) In all monitoring, samples representative of the environmental exposure shall be collected. An adequate number of samples shall be collected to permit the calculation of an environmental exposure for every operation or process.

(2) Environmental monitoring for an operation or process shall be repeated at 30-day intervals where the acetylene concentration has been found to exceed the recommended environmental limit. Monitoring shall continue until two consecutive determinations indicate that exposure to acetylene no longer exceeds the environmental limit.

(b) The employer shall keep records on all industrial hygiene surveys and all determinations of environmental concentrations. Records of the latter shall include the determined concentration of exposure and a description of the monitoring, sampling, and analytical methods. In addition, records shall be maintained on the types of respirators and personal protective equipment, if any, worn by employees. The monitoring records shall identify the employees for whom air samples were collected, and the employer shall make such records available to representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, and of the employee or former employee.

(c) The employer shall keep the records of all environmental monitoring of airborne acetylene for each employee for whom air samples are collected for at least 5 years after the employee's employment is terminated.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational hazards arising from exposure to acetylene. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. It should be pointed out that any criteria and recommended standard should enable management and labor to develop better engineering controls resulting in more healthful work practices and should not be used as a final goal.

These criteria for a standard for acetylene are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of acetylene, and to other occupational exposure to acetylene as applicable under the Occupational Safety and Health Act of 1970. It is intended to (1) protect workers

against fire and explosion hazards, (2) be measurable by techniques that are valid, reproducible, and available to industry and government agencies, and (3) be attainable with existing technology.

It appears from the information available at present that no toxic hazards to employees exist when acetylene is present at concentrations near or up to four times the established lower explosive limit (LEL) of 25,000 ppm. Therefore, the major problem to employees and management is the control of potential fire and explosion hazards from acetylene. However, some commercial grades of acetylene may contain concentrations of impurities (such as phosphine, arsine, and hydrogen sulfide) which could pose a toxic threat to any employee working in operations that involve the production or use of such gases.

The development of the recommended standard for occupational exposure to acetylene has revealed deficiencies of information in chronic inhalation studies at low levels in both humans and animals, in biotransformation studies to determine if acetylene is metabolized, in epidemiologic studies of employees exposed to acetylene for extended periods, in determination of the impurities present in commercial acetylene and of its products of combustion, and in chronic inhalation studies on these impurities and combustion products.