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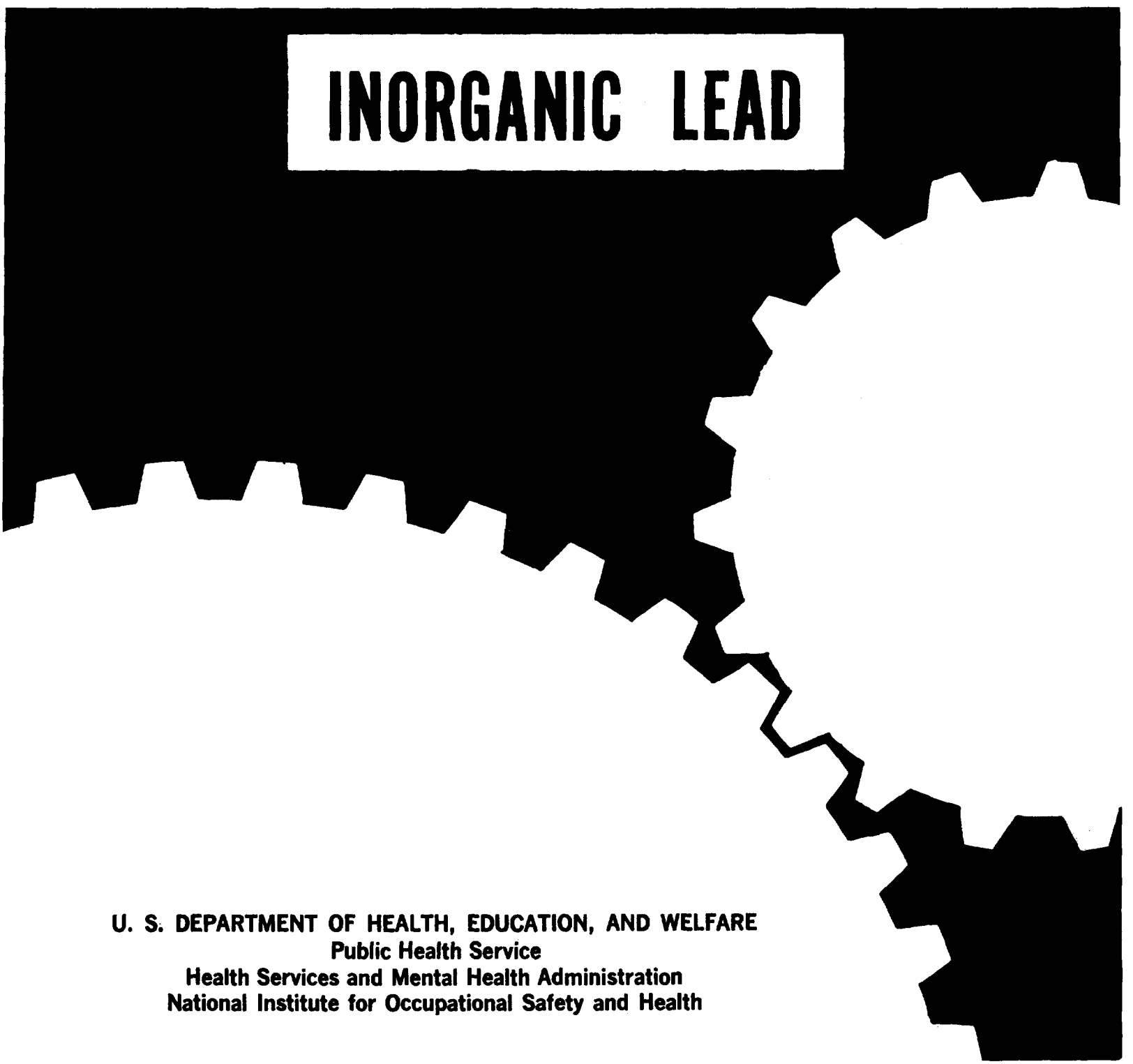
OCCUPATIONAL EXPOSURE TO INORGANIC LEAD



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
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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. To provide relevant data from which valid criteria and effective standards can be deduced, the National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices.

It is intended to present successive reports as research and epidemiologic studies are completed and 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 inorganic lead by my staff and the valuable constructive comments by the Review Consultants on Inorganic Lead, by the ad hoc committee of the American Academy of Industrial Hygiene, by Robert R. O'Connor, M. D., NIOSH consultant in occupational medicine, and Edwin C. Hyatt on respiratory protection. The NIOSH recommendations for standards are not necessarily a consensus of all of the consultants and professional societies that reviewed this criteria document on inorganic lead. A list of the NIOSH Review Committee members and of the Review Consultants appears on pages iii and iv.

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The Office of Research and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for inorganic lead. Keith H. Jacobson, Ph.D., had program responsibility and Robert E. Seiter served as criteria manager.

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CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN OCCUPATIONAL EXPOSURE STANDARD FOR INORGANIC LEAD

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I. RECOMMENDATION FOR AN INORGANIC LEAD STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to inorganic lead in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers for an 8-hour day, 40-hour week over a working lifetime; compliance with the standard should therefore prevent adverse effects of lead on the health and safety of workers. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision as necessary.

"Inorganic lead" means lead oxides, metallic lead, and lead salts (including organic salts such as lead soaps but excluding lead arsenate). "Exposure to inorganic lead" is defined as exposure above half the recommended workroom environmental standard. Exposures at lower environmental concentrations will not require adherence to the following sections, except for Section 7(a).

Section 1 - Environmental (workplace air)

(a) Concentration

Occupational exposure to inorganic lead shall be controlled so that workers shall not be exposed to inorganic lead at a concentration greater that 0.15 mg Pb/m^3 determined as a time-weighted average (TWA) exposure for an 8-hour workday.

(b) Sampling, Collection, and Analysis

Procedures for collection of environmental samples shall be as provided in Appendix I, or by an equivalent method. Analysis of samples shall be as provided in Appendix II, or by any method shown to be equivalent in precision and accuracy to the method specified in Appendix II.

Section 2 - Medical

Medical monitoring (biologic monitoring and medical examinations) shall be made available to workers as outlined below.

(a) Biologic monitoring

Biologic monitoring shall be made available to all workers subject to "exposure to inorganic lead." It consists of sampling and analysis of whole blood, or alternatively, of urine for lead content. Such monitoring shall be performed to ensure that no worker absorbs an unacceptable amount of lead. Unacceptable absorption of lead posing a risk of lead poisoning is demonstrated at levels of 0.080 mg Pb/100 g of whole blood or greater, or at levels of 0.20 mg Pb/liter of urine (with urine specific gravity corrected to 1.024) or greater.

Procedures for sampling and analysis of blood or urine for lead shall be as described in Appendix II, or by any method shown to be equivalent in precision and accuracy. In the case of urine, "spot" urine specimens of about 100 ml shall be collected during a workday, and urine specimens with a specific gravity less than 1.010 shall be discarded and another sample obtained.

Half of all workers subject to "exposure to inorganic lead" shall be offered biologic monitoring every 6 months, so that each worker

shall have blood sampling and analysis made available to him yearly. If urine sampling and analysis are chosen instead of blood lead sampling and analysis to satisfy the biologic monitoring requirement, every worker shall have urine sampling and analysis made available to him at 6 month intervals. The schedule of biologic monitoring, above, may be altered if indicated by a professional industrial hygiene survey. If environmental sampling and analysis show that environmental levels are at or greater than the environmental limit, the interval of biologic monitoring shall be halved, i.e. blood analysis shall be conducted quarterly, with each worker sampled semi-annually, or urinalysis shall be conducted quarterly on every worker. This increased frequency shall be continued for at least 6 months after the high environmental level has been shown.

If a worker's urine lead level is found to be 0.20 mg/liter or greater, calculated to a specific gravity of 1.024, a blood sample shall be obtained and analyzed within two weeks. If a blood lead level of 0.080 mg Pb/100 g or greater is found, and confirmed by a second sample to be taken within two weeks, steps to reduce his absorption of lead shall be taken as soon as the high levels are confirmed. Steps to be considered should include improvement of environmental controls, of personal protection or personal hygiene, and use of administrative controls. A medical examination for possible lead poisoning shall be made available, and the OSHA area industrial hygienist shall be informed of the results of the biologic

sampling of those workers with confirmed, high biologic levels of lead.

Biologic monitoring shall also be made available where the OSHA area industrial hygienist has reason to believe operations produce unusual exposure excursions or that environmental samples do not adequately describe worker exposure.

(b) Medical examination

Medical examinations shall be available when a variance has been granted permitting administrative controls or use of respiratory protection, for workers with unacceptable absorption of lead as judged by biologic monitoring, or when environmental levels are at or above the environmental standard.

These examinations should be made available prior to employee placement and annually thereafter. They should include a physical examination, complete blood counts, blood lead determinations, routine urinalysis (specific gravity, sugar and protein determinations, and microscopic examination), and should record any signs or symptoms of plumbism, if present. Where urine is selected instead of blood for biologic monitoring, the preplacement examination should also include a urinary lead determination. Each employee who absorbs unacceptable amounts of lead as indicated by biologic monitoring shall be examined as soon as practicable after such absorption is demonstrated and confirmed, and at least every 3 months thereafter until his blood or urine lead levels have returned to normal, i.e. below 0.080 mg/100 g of blood or 0.20 mg/liter of urine. If clinical evidence of plumbism

is developed from these medical examinations, the worker shall be kept under a physician's care, in accordance with applicable Workman's Compensation provisions, until the worker has completely recovered or maximal improvement has occurred.

Medical records shall include information on all biologic determinations and on all required medical examinations. These records shall be available to the medical representatives of the employer, of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, and, at the employee's request, to the employee's physician. These records shall be kept for at least five years after the last occupational exposure to inorganic lead.

Section 3 - Labeling (Posting)

Areas where exposure to lead at levels over one-half the workroom air standard is likely to occur shall be posted with a sign reading:

LEAD (Pb)

DANGER!

High concentrations of fume or dust
may be hazardous to health.
Provide adequate ventilation.

If environmental levels are at or greater than the environmental limit, or if a variance permitting use of respiratory controls has been granted, add information to the label or placard describing the location of the respirators.

Section 4 - Personal Protective Equipment and Work Clothing

Subsection (a) shall apply whenever a variance from the standard recommended in Section 1 is granted under provisions of the Occupational Safety and Health Act, or in the interim period during the application for a variance. When the limits of exposure to lead prescribed in paragraph (a) of Section 1 cannot be met by limiting the concentration of lead in the work environment, an employer must utilize, as provided in subsection (a) of this Section, a program of respiratory protection to effect the required protection of every worker exposed.

(a) Respiratory Protection

Engineering controls shall be used wherever feasible to maintain lead dust and fume concentrations below the prescribed limits. Appropriate respirators shall be provided and used when a variance has been granted to allow respirators as a means of control of exposure to routine operations and while the application is pending. Administrative controls should also be used to reduce exposure. Pespirators shall also be provided and used for nonroutine operations (occasional brief exposures above the TWA of 0.15 mg/m^3 and for emergencies); however, for these instances a variance is not required but the requirements set forth below continue to apply. Appropriate

respirators as described in Table I-1 shall only be used pursuant to the following requirements:

(1) For the purpose of determining the class of respirator to be used, the employer shall measure the atmospheric concentration of inorganic lead in the workplace when the initial application for variance is made and thereafter whenever process, worksite, climate or control changes occur which are likely to affect the lead concentration. The employer shall test for respirator fit and/or make lead measurements within the respiratory inlet covering to ensure that no worker is being exposed to inorganic lead in excess of the standard either because of improper respirator selection or fit.

(2) Employees experiencing breathing difficulty while using respirators shall be referred to a physician for evaluation. This evaluation should investigate if the employee has adequate ventilatory capacity and any evidence of obstructive lung disease. Employees with inadequate ventilatory capacity or evidence of obstructive lung disease shall not wear types A, B, and E respirators.

(3) A respiratory protective program meeting the general requirements outlined in section 3.5 of American National Standard for Respiratory Protection Z88.2-1969 shall be established and enforced by the employer.

(4) The employer shall provide respirators in accordance with the Table below and shall assure that the employee uses the respirator provided.

(5) If both fume and dust are present, the recommended usage is that for fume.

(6) Respiratory protective devices described in the following Table I-1 shall be either those approved under the following listed regulation or those approved under 30 CFR 11, published March 25, 1972. The termination date of currently approved respirators described in 30 CFR 11 shall apply.

(i) Reusable or replaceable filter-type air-purifying respirator - - - 30 CFR 14 (Bureau of Mines Schedule 21 B)

(ii) Powered air-purifying positive-pressure respirator - - - 30 CFR 14 (Bureau of Mines Schedule 21 B)

(iii) Type C positive-pressure supplied air respirator - - 30 CFR 12 (Bureau of Mines Schedule 19 B)

(7) Usage of a respirator specified for use in higher concentrations of lead is permitted in atmospheres of lower concentrations.

(8) Employees shall be given instruction on the use of respirators assigned to them, cleaning of the respirators, and how to test for leakage.

TABLE I-1

Requirements for Respirator Usage

at Concentrations Above the Standard

Exposure	8 Hr TWA mg/m^3	*Respirator type
Inorganic lead dust	less than 1.5	A,B
	less than 15.0	C
	greater than 15.0	D
Inorganic lead fume	less than 1.5	E
	less than 15.0	F
	greater than 15.0	D

* A - Reusable or replaceable filter-type air-purifying dust respirator

B - Single-use dust respirator

C - Powered air-purifying positive-pressure dust respirator

D - Type C positive-pressure supplied air respirator

E - Replaceable filter-type air-purifying fume respirator

F - Powered air-purifying positive-pressure fume respirator

(b) Work Clothing

(1) Each employee subject to exposure above the environmental standard of Section 1 should wear coveralls or similar full body work clothing and hat, which should be worn during the working hours in areas where there is exposure to lead. Workers subject to "exposure to inorganic lead" at or below the recommended standard should change into work clothing before starting work, and should remove work clothing before leaving work. This work clothing need not afford full body coverage.

(2) Work clothing should be vacuumed before removal. Clothes shall not be cleaned by blowing or shaking.

(3) Work clothing should be changed at least twice a week and more frequent changes, especially in high exposure areas, are suggested.

(4) Adequate shower facilities should be available and used.

(5) When in the judgment of the OSHA area industrial hygienist contamination of clothing or exposed body surfaces can produce significant secondary exposures, items (1), (2), (3), and (4) above shall be mandatory.

Section 5 - Apprisal of Employees of Hazards from Lead

(a) Each employee exposed to lead shall be apprised at the beginning of his employment or assignment to a lead area of all hazards, relevant symptoms, appropriate emergency procedures, and proper conditions and precautions for safe use or exposure and shall be instructed as to availability of such information which shall be kept on file including that prescribed in (b) below and shall be accessible to the worker at each place of employment where lead is involved in unit processes and operations.

(b) Information as specified in Appendix III shall be recorded on U. S. Department of Labor Form OSHA-20, "Material Safety Data Sheet", (see page IX-4 and IX-5), or on a similar form approved by the Occupational Safety and Health Administration, U. S. Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

(1) Procedures including fire fighting procedures shall be established and implemented to meet foreseeable emergency events.

(2) Respirators shall be available for wearing during evacuation procedures if long distances need to be traversed; supplied air respirators shall be available for employee use where equipment or operations cannot be abandoned.

(b) Exhaust Systems

Where a local exhaust ventilation and collection system is used, it shall be designed and maintained to prevent the accumulation of lead dust and fume.

(1) Hazardous types of exposure should not be scattered throughout a plant but, rather, concentrated in a single area where special control procedures can be utilized.

(2) Air from the exhaust ventilation systems shall not be recirculated into the workroom, and should not be discharged outside the plant so as to create an air pollution problem.

(c) General Housekeeping

(1) Vacuuming shall be used wherever practicable and no dry sweeping or blowing shall be performed.

(2) Emphasis shall be placed upon cleanup of spills, periodic repair of equipment and leaks, proper storage of materials, and collection of lead-containing dust.

Section 7 - Sanitation Practices

(a) Food Facilities

Food preparation, dispensing (including vending machines), and eating shall be prohibited in lead work areas.

(b) Locker Facilities

Work and street clothing should not be stored in the same locker.

Section 8 - Monitoring, Recordkeeping, and Reporting Requirements

Workroom areas where it has been determined, on the basis of an industrial hygiene survey or the judgment of a compliance officer, that environmental levels do not exceed half the environmental standard shall not be considered to have inorganic lead exposure. Records of these surveys, including the basis for concluding that air levels are below half the environmental standard, shall be kept.

Requirements set forth below apply to inorganic lead exposures.

(a) Employers shall monitor environmental levels of lead at least every 6 months, except as otherwise indicated by a professional industrial hygiene survey. If environmental levels are at or above the standard, environmental levels shall be monitored every 3 months. This increased frequency of monitoring shall be continued at least 6 months (i.e. two more quarterly monitoring periods) after the last sampling that demonstrated levels at or above the environmental limit.

Periodic environmental sampling shall be performed to coincide with periodic biologic sampling, i.e. shall be performed within 2 weeks of biologic sampling.

Breathing zone samples shall be collected to permit construction of a time-weighted average exposure for every operation. The following number of samples shall be collected and analyzed, as a minimum, based on the number of workers exposed in any given work area:

Number of Employees Exposed	Number of Samples
1-20	50% of the number of workers
20-100	10 samples plus 25% of the excess over 20 workers
over 100	25 samples plus 5% of the excess over 100 workers

(b) When any time-weighted average exposure is at or above the environmental standard, the OSHA area industrial hygienist shall be notified.

(c) Records shall be maintained for all sampling schedules to include the sampling methods, analytical methods, type of respiratory protection in use (if applicable), and the concentrations of lead in each work area. Records shall be maintained so that they can be classified by employee. Each employee shall be able to obtain information on his own environmental exposure.

(d) Medical records shall include information on all biologic determinations and of all required medical examinations. These records shall be kept for at least five years following the last occupational exposure to inorganic lead.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to inorganic lead. 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 recommended criteria for a 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 inorganic lead are in a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, and use of lead products as applicable under the Occupational Safety and Health Act of 1970.

The occupational safety and health aspects of the mining and milling of lead ores are covered by provisions of the Federal Metal and Non-metallic Mine Safety Act (30 U.S.C. 725 et seq.) under which provisions the Bureau of Mines has responsibility.

These criteria were developed to assure that the standard based thereon would (1) protect against development of acute and chronic plumbism, (2) be measureable by techniques that are valid, reproducible, and available to industry and governmental agencies, and (3) be attainable with existing technology.