PLAINTIFF'S
EXHIBIT
DUP-1049

MEASUREMENT AND CONTROL OF ASBESTOS DUST EXPOSURE

SAFETY
ENGINEERING STANDARD

ISSUED APRIL 1973
REVISED OCT 1979
STANDARD REAFFIRMED OCT 1979

S 4 T
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This standard includes requirements of the Occupational Safety and Health Act of 1970 (OSHA) as published in the Federal Register. OSHA information is printed in red.

1. SCOPE

1.1 This standard presents the permissible asbestos dust exposure limits, methods of controlling asbestos dust exposures, special OSHA requirements for removal of asbestos insulation, respiratory protective equipment, and method of sampling asbestos dust concentrations in the work area. It provides sufficient information to comply with OSHA and EPA regulations but guidance from the Du Pont Legal Dept should be sought whenever an interpretive problem arises.

1.2 An Asbestos Compliance Package can be obtained from The Occupational Environmental Control group of ESD. Ref (1) contains extensive additional information.

2. GENERAL

2.1 Asbestosis and cancer are associated with exposure to asbestos. Historically, the incidence of these diseases has been significantly higher among asbestos workers than among the general population. Cigarette smoking greatly increases the incidence of respiratory cancers from exposure to asbestos. Asbestos-exposed persons who smoke have a 90-fold increase in risk from lung cancer over nonsmokers Ref (2).

2.2 Principal potential sources of exposure to airborne asbestos dust in Company operations are:

a. Removing old asbestos-containing insulation from lines and vessels

b. Removal, handling, and laundering of asbestos-contaminated clothing

c. Cutting asbestos cement (Transite) siding, roofing, pipe, etc, or Haveg pipe and equipment

d. Maintenance and operation of machinery and vehicle brake linings

e. Opening boxes and removal of new asbestos materials

f. Handling asbestos materials used in production of Company products

g. Repair of laboratory equipment with asbestos insulated heaters (e.g., gas chromatographs, lab ovens)

h. Cleaning and maintenance of vacuum systems for collection of asbestos fibers

2.3 Suitable nonasbestos substitutes should be sought for asbestos-containing materials whenever their use can result in a release of asbestos fibers.

2.4 Some materials containing bound asbestos fibers are not hazardous during normal use. Examples are: bonded compressed asbestos gaskets, asbestos roofing felt, Teflon[®] impregnated asbestos packing and fibrated asphalt cutback (mastic). These materials could become hazardous if asbestos fibers are released because of loss of binder or a physical action such as grinding.

2.5 A material which contains asbestos which might become airborne should be treated as asbestos unless it is determined that the asbestos present is not a potential health hazard. Talc, vermiculite, and other minerals are listed by Appendix I of Ref (1) as possibly containing asbestos.

3. PERMISSIBLE EXPOSURE LIMITS

3.1 Asbestos fibers concentrations in air shall not exceed an 8-hour time-weighted average (TWA) of 2 fibers longer than 5 micrometers per cm^3 of air. At no time may the concentration exceed a ceiling of 10 fibers longer than 5 micrometers per cm^3.

3.1.1 The 8-hour time-weighted average (TWA) is the average concentration occurring over a period of 8 continuous hours.

3.1.2 By far the majority of asbestos used for insulation is the chrysotile form. Other forms of asbestos that have lower proposed exposure limits (ACGIH TLVs) are rarely used. For more complete information on these other limits refer to S2T Table 4. The OSHA permissible exposure limit listed in 3.1 is the same for all forms of asbestos.

4. CONTROL OF ASBESTOS DUSTS

4.1 Engineering Controls such as, but not limited to, isolation, enclosure, exhaust ventilation, and dust collection shall be used to meet the permissible exposure limits in 3.1.

4.1.1 Local exhaust ventilation and dust collection systems shall be in accordance with ANSI Z9.2-1971, "Fundamentals Governing the Design and Operation of Local Exhaust Systems."

4.1.2 Additional information on the design of ventilation systems is contained in DH1U, H3U, DG20D and Ref (1) and (6).

4.2 Handling Asbestos

4.2.1 Insofar as practical, asbestos shall be handled, mixed, applied, removed, cut, scored, or otherwise

Portions printed in red text OSHA regulations, Section 1910.1001 (formerly .93a)

Vendors and merchandise designations are given to describe materials and may not include all acceptable products. Substitutions by suppliers are to be made only on approval of the local authority initiating the use of this standard.

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worked in a wet state sufficient to prevent the emission of airborne fibers in excess of the exposure limits in section 3.

4.2.2 **Housekeeping.** All external surfaces shall be maintained free of asbestos fibers if, with their dispersion, there would be an excessive concentration.

a. All areas where asbestos is routinely handled shall have a vacuum cleanup system. This can be a system of hoses connected to a central vacuum system designed in accordance with 4.1.1.

b. No dry sweeping shall be performed. Compressed air hose is not to be used for cleanup.

4.2.3 Caution signs and labels shall be used per section 11.

4.2.4 No asbestos cement, [illegible] material containing dry [illegible] removed from bags, cartons, or [illegible] in which they are shipped without being either [illegible] or ventilated so as to prevent effectively the [illegible] asbestos fibers in excess of the limits [illegible]

4.3 Tools Used on Asbestos

4.3.1 Avoid sawing where possible; knife cutting is preferred.

4.3.2 All hand-operated and power-operated tools which may produce or release asbestos fibers in excess of the permissible exposure limits (i.e., saws, scorers, abrasive wheels, and drills) shall be provided with a dust-collection system as specified in 4.1.

4.3.3 All asbestos-cutting operations should be isolated to minimize unauthorized access. This can be a temporary area for nonroutine operations with barricades and signs per section 12. Routine work should be isolated in a properly posted separate work area.

4.4 Removal of Asbestos Insulation

4.4.1 If the composition of the material is unknown, it shall be treated as being asbestos. For use of labels to identify nonasbestos insulation, see SN218P.

4.4.2 Proper respirators (per section 5) and special protective clothing (per section 9) shall be provided to employees engaged in removal or demolition of [illegible] insulation or covering. **Atmosphere supplying respirators (5.4) are required except where it has clearly been demonstrated that the wet method is effective and monitoring has shown that levels on the job have resulted in lower exposures.**

4.4.2.1 At a minimum, air purifying respirators (5.3) and special clothing shall be worn during the removal of asbestos insulation. Many plants have found disposable dust masks (5.3.1) (NIOSH approved for asbestos) and disposable paper clothing, satisfactory.

a. This requirement does not apply to removal of insulation, fabricated, and protected to withstand repeated removal and reinstallation for equipment maintenance or other reasons, providing the techniques employed have been demonstrated to maintain asbestos concentrations within exposure limits of section 3.

b. The clothing requirement does not apply to removal for maintenance or alterations when the wet method is used and monitoring of identical work has shown the precautions maintain asbestos concentrations within the ceiling limit of section 3.

4.4.3 The work area shall be barricaded and caution signs shall be posted as described in section 12 at approaches to areas where asbestos materials are being handled. This requirement does not apply under conditions described in 4.4.2.1 a and b.

4.4.4 [illegible] **Wetting may have to be suspended on outside operations when temperatures get below 0°C. If asbestos cannot be wetted due to freezing temperatures, it should to the extent possible be removed as unit sections.**

4.4.5 Support fasteners shall be removed with care. Handle asbestos-containing materials in such a manner to minimize generation of airborne asbestos fibers. Do not drop.

4.4.6 Removed asbestos materials shall not be allowed to accumulate in the work area but shall be immediately sealed in bags.

4.4.7 Maintain good housekeeping. Vacuum equipment meeting requirements of 4.1.1 shall be used to prevent loose accumulations of fragments.

5. RESPIRATORY EQUIPMENT

5.1 Respiratory protection [illegible] personnel in areas where permissible exposure limits may be exceeded. Respiratory protection [illegible] permissible [illegible] limits [illegible] under the [illegible] conditions:

a. During the time necessary [illegible] controls. **Written plans for the installation of engineering controls or reasons why they are not feasible should be available.**

b. [illegible]

c. [illegible]

5.2 [illegible]

5.2.1 Standard S2H should be referred to for further guidance in establishing a respirator program.

5.2.2 [illegible]

[illegible] OSHA [illegible] Section 1910.1001 [illegible]

5.3 Air purifying [illegible] shall be used when the TWA or [illegible] reasonably expected to exceed [illegible] limits in section 3.

5.3.1 **Although OSHA permits use of both single use or reusable air purifying respirators for up to 10 times the limits in section 3, more recent respirator testing has indicated that single use and quarter-mask respirators should not be used for more than 5 times the limits Ref (10), (11), and (12). Half-face air purifying respirators are acceptable for use at up to 10 times the limits.**

5.4 Atmosphere supplying (Type "C") continuous flow or pressure-demand supplied-air respirators, (table [illegible] of S2H) respirators shall be used when the TWA or ceiling concentrations are reasonably expected to exceed 10 times the limits in section 3.

5.5 While powered air purifying respirators are permitted by OSHA when concentrations are expected to be between 10 and 100 times the limits in section 3, these units are seldom used on Company plants.

6. IDENTIFICATION OF ASBESTOS IN MATERIALS SUSPECTED OF CONTAINING ASBESTOS

6.1 Field Methods. There is no reliable field method for confirming the absence of asbestos in materials suspected of containing asbestos. Visual examination alone is not sufficient to confirm the absence of asbestos.

6.1.1 A flame test Ref (9) using a propane torch can be used to screen samples. This test provides reliable indications of the presence of asbestos, but does not provide a reliable indication of the absence of asbestos.

6.2 Laboratory Methods. Microscopic examination can be used to determine the presence or absence of asbestos in most cases. When results of the microscopic examination are inconclusive, **x-ray diffraction** will provide reliable results.

6.2.1 Samples (approximately 1 gram) can be sent to Marshall Lab (7.4.1) for microscopic examination. Marshall Lab will arrange for x-ray diffraction analysis if the results of the microscopic examination are inconclusive.

6.2.2 **Samples can be sent to the Analytical and Physical Measurement Group, PP&R, Experimental Station for x-ray diffraction analysis.**

6.2.3 The K^2 Test for Screening Asbestos developed by NIOSH can be used to screen for asbestos. This test provides reliable indications of the absence of asbestos. However, because the test is nonspecific, it will give false positive identifications.

7. MONITORING

7.1 Monitoring is required where employees may be exposed to asbestos but [illegible] work related [illegible] mine the employee's [illegible]

7.2 Types of Monitoring

[illegible] Personal [illegible]

[illegible] used to [illegible] of [illegible] sampling filter [illegible] to the [illegible] breathing zone of employees.

7.3 Sampling frequency and patterns shall be such that samples represent the level of exposure of employees with reasonable accuracy. Samples for determination of both 8-h or time-weighted average and ceiling concentrations shall be taken.

7.3.1 Samples shall be taken for each type of job or when a job is changed in such a way as to increase asbestos exposure.

7.3.2 For employees whose exposure may reasonably be foreseen to exceed the limits of section 3 sampling shall be done at intervals not greater than 6 months.

7.3.3 Ceiling samples shall be taken for those short tasks for which highest exposure is expected. **Ceiling samples for OSHA compliance testing should be taken for 15 minutes. Short-term samples may also be taken for shorter or longer periods (duration of a given task) for investigative purposes.**

7.4 Procedures

7.4.1 Methods of sampling asbestos fibers in air are given in Ref (3). Sampling procedures should be reviewed with the laboratory which will count the fibers prior to sampling to help ensure proper techniques are used. Qualified laboratories, are:

E. I. du Pont de Nemours & Co
Analytical Section
Marshall Laboratory
3500 Grays Ferry Avenue
Philadelphia, PA 19146

Clayton Environmental Consultants
2571 Southfield Road
Southfield, MI 48075

National Loss Control Service Corp
(Lumberman Mutual Casualty Co)
Environmental Sciences Laboratory
Long Grove, IL 60049

The sample should be taken at a rate of 1.5 to 2 liters per minute. The filter face should be positioned so that fibers will not settle on it.

7.4.2 Sampling atmospheres containing asbestos fiber with low levels of other dusts:

a. For exposures expected to be below 2 fibers per cm^3, sample for 2 to 8 hours.

Portions printed [illegible]

b. For exposures expected to be above 2, but less than 5 fibers per cm^3, sample for 45 minutes to 4 hours.

c. For exposures expected to be higher than 5 fibers per cm^3, sample for 30 minutes to 2 hours depending upon experience and consultation with the laboratory which will count the fibers.

7.4.3 Sampling atmospheres containing asbestos fibers with high levels of other dusts: sample times will vary depending upon the amount of other dusts present. The laboratory which will count the fibers should be consulted to obtain approximate sample times.

7.4.4 **Equipment** All sampling must be done on membrane filters of 0.8 micrometers porosity mounted in an **open-faced** filter holder. The Millipore cellulose acetate 0.8 micrometer filter, catalog number MAWP 037A0, is recommended. Particulate sampling equipment is described in S13T, section 10.

7.4.5 **Analysis** must be done at qualified laboratories. Completed samples are placed in a mailing tube, sealed, and sent to a qualified laboratory with 2 copies of the sampling record.

a. It is recommended that an unexposed filter be included with each batch of samples as a blank.

b. All determinations shall be made by the membrane filter method at 400 to 450X (magnification) (4mm objective) with phase contrast illumination.

7.5 **Employee Notification.** Employees should be notified of exposure monitoring results. Any employee found to have been exposed above the permissible exposure limits in section 3 shall be notified, in writing, within 5 days of the finding and of corrective action being taken. Notification is required even if employee was wearing protective equipment at the time of exposure.

7.6 **Exposure records** shall be maintained at least 20 years. Other recordkeeping requirements will generally require records be kept for longer periods.

7.6.1 Employees and former employees shall have reasonable access to records which indicate the employee's own exposure to asbestos.

7.7 Affected employees or their representatives shall be given reasonable opportunity to observe monitoring and review the results.

8. MEDICAL SURVEILLANCE

8.1 Each site should maintain list(s) of employees who have documented asbestos exposure. The plant medical group must be kept informed of those listed. The list(s) should identify the following.

8.1.1 Those currently exposed to asbestos:

a. All employees working in jobs that require handling of asbestos which might become airborne (such as carpenters working with Transite, insulators, pipefitters, and millwrights).

b. All employees working in jobs which are exposed to measurable quantities of asbestos. The lower limit of reliable quantification of the required measurement technique is 0.1 fibers/cm^3 of air, see Ref (4).

8.1.2 Those who during their Du Pont employment have previously worked in jobs with an exposure described in 8.1.1.

8.1.3 Those with a known off-plant asbestos exposure prior to or during employment at Du Pont. At time of employment and periodically thereafter, care should be taken to record any history of off-plant exposure to asbestos.

8.1.4 Those whose x-rays show changes of the type which are known to result from asbestos exposure.

8.2 **Medical Examinations.** Preplacement, annual, and termination medical examinations must be made available to employees in an occupation exposed to asbestos. These examinations must include, as a minimum, a PA chest x-ray, medical history, and pulmonary function tests.

8.3 "Guidelines for Physicians" [see Ref (5)] contains additional information on interpretation and frequency of x-rays for asbestos exposed employees.

9. CLOTHING AND CHANGE ROOMS

9.1 Special clothing, such as coveralls, head covering, gloves, and foot covering shall be required where exposures exceed ceiling limits of section 3 and during removal of asbestos insulation, see [illegible].

9.2 Change rooms shall be provided for all employees working in jobs in which the 8-hour TWA or ceiling limit of section 3 are exceeded.

9.2.1 Separate clothing lockers or similar arrangements are required in these change rooms to prevent contamination of street clothes from work clothing.

9.3 Laundering of asbestos-contaminated clothes must be done to prevent the release of asbestos fibers into the [illegible]

9.3.1 [illegible] laundering [illegible] be informed of the need to prevent release of asbestos fibers.

3.3.2 Contaminated clothing shall be transported in sealed impermeable containers labeled in accordance with section 12.

10. EPA ASBESTOS EMISSION REGULATIONS

10.1 **Application.** Regulations also have been promulgated by the Environmental Protection Agency (EPA), Ref (7). These apply to friable asbestos materials which contain more than 1 percent asbestos by weight and which can be crumbled, pulverized, or reduced to powder by hand pressure when dry. Du Pont operations within this criterion normally will be limited to renovation or demolition involving asbestos insulation.

10.1.1 **Renovation** involves removing or stripping away asbestos from pipes, ducts, boilers, tanks, reactors, furnaces, other equipment or structural members. **Demolition** involves wrecking or removal of a load-supporting structural member (beams or load-supporting walls) and any related removing or stripping of friable asbestos materials. During **demolition** asbestos shall be removed or stripped prior to the wrecking or taking out of load-supporting structural members.

[illegible]

10.1.2 When an individually scheduled renovation or demolition job amounts to more than the quantities listed below, a detailed report shall be filed with EPA (and in some cases a state or local agency) prior to removal. The removal operation shall follow the other requirements of this standard, particularly 4.4.

a. 260 linear ft (80 m) of asbestos containing pipe insulation

b. 160 ft^2 (15 m^2) of asbestos-containing insulation on ducts, boilers, tanks, or structural members

For planned, but not individually scheduled, renovations a long-range estimate of the total amount of asbestos to be removed or stripped must be made. The period covered must be at least 30 days, but not more than a year. EPA must be given notice if the amounts estimated exceeds 10.1.2 a or b.

10.1.3 When renovation amounts to less than 10.1.2 a or b, notice to EPA is not required.

10.1.4 When demolition amounts to less than 10.1.2 a or b, a simplified report shall be filed with the EPA prior to removal. The removal operation also shall follow the other requirements of this standard, particularly 4.4.

10.1.5 The requirements of this standard should more than meet the additional precautions specified by EPA regarding wetting, containerizing, disposal, and exhausting.

10.2 Waste Disposal. All asbestos waste, including items such as scrap, empty bags or clothing to be discarded, vacuum system collection, and other wastes which may create airborne dust concentrations, shall be collected and disposed of in sealed, impermeable bags, or containers. Caution labels shall be attached conforming to section 12.

10.2.1 All disposal sites must have specific warning signs, fencing, and dust suppression methods as required by the EPA regulation (40 CFR 61.25).

10.3 For specific report and compliance requirements, refer to the EPA regulations, section 61.22d of Ref (7). Local or state regulations also should be reviewed since they may be more restrictive.

11. TRAINING

11.1 In areas where people work with asbestos, employees should be trained with the goal of increasing knowledge of:

a. Work practices involving asbestos and the potential for fiber emissions

b. The physical characteristics of asbestos

c. Diseases which may result from exposure to asbestos fibers including the role of smoking in lung cancer

d. Reasons for, and methods of, exposure monitoring

e. The purpose and nature of engineering and work practice control methods, personal protective equipment and clothing, and personal hygiene

f. The elements of medical surveillance

12. CAUTION SIGNS AND LABELS

12.1 Caution signs conforming to Figure 1 shall be posted at all approaches to areas where asbestos concentrations may be above permissible exposure limits. They shall be placed at a sufficient distance to permit an employee to read the signs and take necessary precautions before entering the area.

12.2 Caution labels conforming to Figure 2 shall be used to identify containers of raw materials, scrap, waste, other products containing asbestos, and asbestos-contaminated clothing.

12.3 Identification labels are suggested for identification of asbestos-containing and asbestos-free insulation, see SN218P.

13. REFERENCES

1. Asbestos: An Information Resource, National Cancer Institute, DHEW Publication No. (NIH) 78-1681 (May 1978).
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3. NIOSH Method P&CAM 239: "Asbestos Fibers in Air," NIOSH Manual of Analytical Methods, Second Ed, Vol 1, DHEW (NIOSH) Publication No. 77-157-A.
4. "USPHS/NIOSH Membrane Filter Method by Evaluating Asbestos Fibers," NIOSH Technical Report No. 79-127 (February 1979).
5. Du Pont Medical Division, "Guidelines for Physicians," Section R, Interpretation of X-rays (March 29, 1979).
6. "Industrial Ventilation - A Manual of Recommended Practice," 15th Ed, American Conference of Governmental Industrial Hygienists (1978).
7. National Emission Standard for Asbestos, Title 40, Code of Federal Regulations: Subpart B, 61.20 through 61.25 (40 CFR 61.20-61.25). Originally published in Federal Register, 48292 (October 14, 1975).
8. Occupational Safety and Health Standards, Part 1910, sections 1910.1001 and 1910.134 (29 CFR 1910).
9. Pabco Technical Bulletin PTB - 48-7A, "Asbestos Identification in Old Calsil Insulation" (February 15, 1979).
10. NIOSH/OSHA Respirator Decision Logic, OSHA Industrial Hygiene Manual, Chapter III.
11. E. Hyatt, "Respirator Protection Factors," Los Alamos Scientific Laboratory Publication LA-6084 (January 1976).
12. P. L. Lowry et al, "Performance of Single-Use Respirators," American Industrial Hygiene Assoc J., 38, p 462 (September 1, 1977).

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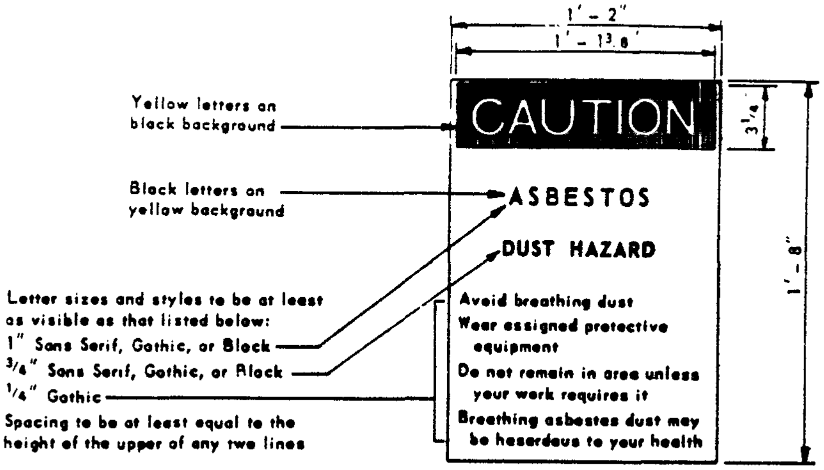
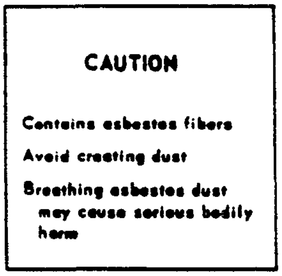


FIGURE 1 – CAUTION SIGN, ASBESTOS DUST



CAUTION

Contains asbestos fibers

Avoid creating dust

Breathing asbestos dust may cause serious bodily harm

Label size and printing to be readily visible and legible.

FIGURE 2 – TYPICAL CAUTION LABEL *

* Available from M & M Displays, 3301 Maiden Lane, Philadelphia, PA 19145

[illegible] 1 and 2 meet OSHA re[illegible] ements Section 1910 [illegible] (formerly 9[illegible]