PLAINTIFF'S EXHIBIT WRG-1738

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TABLE I

Composition of Sprayed Mineral Fiber Products
Depending on manufacturer, the product may contain the following:

Decorative and acoustical[a]	Manufactured silicate fiber (such as Rock Wool) Asbestos fiber Mineral binders Clays – bentonite Hydraulic setting binders Portland cement	Oversprays Emulsion type sealers Latex Acrylic Resin Paint
Thermal[b]	Amosite asbestos fiber Crocidolite asbestos fiber Chrysotile asbestos fiber Manufactured silicate fiber (such as Rock Wool) Hydraulic setting binders Portland cement Aluminum silicate extruded fibers ("ceramic")	Dust-arresting additives Wetting agents Oils
Fireproofing (cementicious)[a]	Chrysotile asbestos fiber Gypsum Portland cement Vermiculite	

[a]Contains 5 to 30% asbestos fiber.
[b]Contains nearly 100% asbestos fiber.

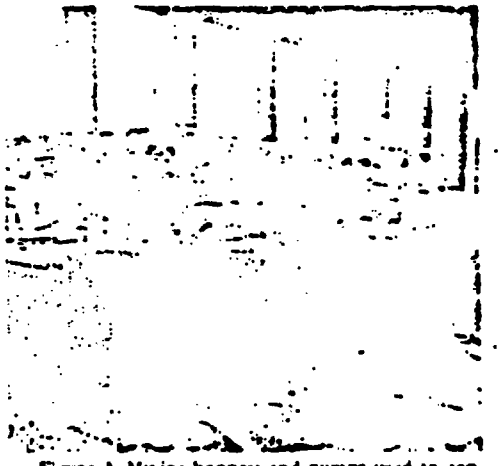

Figure 1. Mixing hoppers and pumps used to convey material to point of application.

land-American ocean liner Rotterdam contains 400,000 square feet of sprayed mineral fiber used for fire protection, thermal insulation, and sound and condensation control. Most sprayed material is used in large cities. During 1970, in New York City, there were six to eight buildings taller than thirty stories being sprayed on any given day. An estimated 2500 tons were used in Great Britain during 1968. Use as a fireproofing agent consumed most of Britain's spray insulation material.

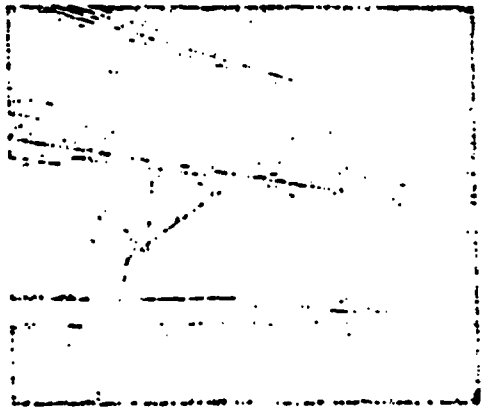

Figure 2. [illegible] containing asbestos. Note waste material on floor. Worker is wearing respiratory protection, inadequate for such intense exposure.

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Methods of Application

There are two principal methods of applying sprayed mineral fiber. In the dry method, dry material is dumped from a paper shipping bag into a large hopper, where the material is agitated and subsequently blown into a 2- or 4-inch hose (Figure 1). The hose conveys the dry material to a nozzle at the actual site of application (Figure 2). As the dry material leaves the nozzle, it passes through the focus of a ring of fine water jets. Mixing takes place at this focal point, which is usually 4 to 8 inches from the end of the nozzle. The operator is able to control the air, material, and water mix, with valves at the nozzle.

The wet method differs in that the material is premixed with water in the hopper, and the resulting slurry is pumped to the nozzle and sprayed upon the surface to be coated. The nozzle used is similar to that used to apply plaster.

Exposure of Workmen

Spraying of mineral fiber is done by men in several different trade unions in the United States, depending on its purpose and local jurisdictional agreements. All material that is used for thermal insulation is applied by members of the International Association of Heat and Frost Insulators and Asbestos Workers (AFL-CIO). This is a very minor part of their work, overall. Material used for fireproofing is often applied by members of the Plasterers' Union. Acoustical and decorative material may be handled by carpenters, or other craftsmen. In New York City, fewer than 1000 men in all would have regular or intermittent exposure to sprayed asbestos insulation.

The application of sprayed mineral fiber compounds containing asbestos is potentially associated with health hazards for two groups of people and possibly for a third. The first group, workmen actually engaged in applying the material, is relatively small in numbers. This group, however, is the most heavily exposed. Air samples taken on site and counted by using a modification of the method described by Ayer and Lynch,[8] counting only fibers longer than 5 microns visible by optical microscopy at 400x, indicated that the worker handling the nozzle was exposed to fiber levels ranging from a low of 30 f/cc to over 100 f/cc. The worker emptying the bags into the hopper was found to be exposed to fiber levels ranging from 5 f/cc to 22 f/cc. The large spread in counts can be attributed to differences in asbestos content of material, work proficiency, and the ever-changing conditions on construction sites (see Table II). These dust levels are much higher than those at asbestos work sites in other trades.

TABLE II

Spraying of Thermal Insulation – Power House Turbine[a]

Man at Nozzel (1)	Man at Nozzel (2)	Man Charging Hopper
65	67	22
85	45	5
31	100	10
24	32	6

Spraying of Fireproofing – Multistory Building

Man at Nozzel (3)	Man at Nozzel (4)
30	99.0
43	94.5
20	
49	
34	

[a]All counts in fibers per cubic centimeter. Fibers longer than 5 microns, visible by optical microscopy at 440x with phase microscopy. Our studies have demonstrated that many more fibers shorter than 5 microns, too small to see by optical microscopy, accompany the optically visible fibers and may exceed them in number (although not in mass) by several orders of magnitude. These smaller and thinner fibers and fibrils are detected only by electron microscopy and are not included in counts such as these.[9]

There are no satisfactory data at present concerning disease among these men with direct exposure to sprayed insulation dusts. Their work experience in general has been too short to have led, as yet, to clinically evident disease. Among other asbestos-exposed workmen, significant disease usually does not become evident for twenty or more years following onset of exposure.[10] No group of workmen engaged

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pected, such contamination is greatest in the vicinity of the construction site.

Since most of the spraying is done before the building curtain walls are erected, some of the spray material may blow outside the site. The quantity that escapes depends on wind, height of building, skill of operator, material, and control measures used. Construction sites have been studied where grossly visible waste from a spray application covered the ground to a depth of 1 inch for a distance extending 100 feet from the site (Figure 4).

Control of Occupational Asbestos Hazards Associated with Sprayed Insulation

The two most important sources for workman exposure during spray operations are (1) material that becomes airborne during the spray operation (overspray), both that which remains at the job site and that which blows into the surrounding air, and (2) material that remains on the site because of poor housekeeping. Until recently, few control measures were used during application of sprayed mineral fiber.

During 1969 and 1970, extensive field investigations were undertaken by our laboratory to ascertain the possible asbestos hazard in this trade and to develop corrective measures. In this, we had considerable cooperation from the Department of Air Resources of the City of New York, and some segments of the sprayed insulation industry, including a number of manufacturing and contracting firms associated with the Sprayed Mineral Fiber Manufacturers Association and the Contracting Plasterers' Association of New York. The International Association of Heat and Frost Insulators and Asbestos Workers, AFL-CIO, although its members did little such work (rather, Plasterers' Union members were engaged), also provided considerable help, since they had had much bitter experience with the problem in general.[16] Similarly, valuable assistance was provided by the Johns-Manville Corporation, in keeping with their general perspective of developing effective controls for such asbestos uses as might be associated with hazard.

In this investigation, work sites were studied in eleven cities in eight states. Practices were found to be very much the same throughout the country, as described above.

It is our general conclusion that sprayed insulation practices can be controlled to a point at which the occupational hazards, both direct and indirect, can be minimized or eliminated, but that such controls will be expensive, tedious, and cumbersome.

Our findings may be summarized by consideration of the Sprayed Insulation Regulations promulgated by the City of New York in April, 1970. These regulations were largely based upon the results of our studies, supplemented by valuable additions derived from the experiences of the Department of Air Resources (Dr. Robert Rickles, Commissioner) and its staff, including those of Harold Romer, P.E., who headed a special group assigned to this problem. These regulations were the first by a governmental agency to seek to control hazards associated with sprayed insulation and have more recently been followed by administrative actions in other cities including Philadelphia, San Francisco, Boston, and Chicago.

In the Matter of the Spraying of Asbestos-Containing Material	)))	Commissioner's Order

PURSUANT to the authority vested in me by the New York City Charter and the New York City Air Pollution Control Code.

IT IS HEREBY ORDERED that whenever asbestos-containing material is sprayed, the following precautions shall be taken to prevent and control the emission of asbestos-containing particulate matter into the ambient air.

1. Before the start of spraying operations all floor areas shall be shoveled clean. Before the application of asbestos-containing material commences, the floor of the area shall be cleared of all objects, material and equipment other than that employed in the application of the asbestos-containing insulation or all objects, materials, etc., shall be covered with plastic or other approved tarpau-

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lins in a manner that precludes the subsequent dispersal of asbestos particulates.

2. The entire floor, or the part of the floor to be insulated shall be enclosed with plastic or other approved tarpaulins in a manner which shall preclude the escape of asbestos-containing material from the enclosure. All interior open areas, such as elevator shafts, stairwells, etc., shall be enclosed in a manner which shall prevent the escape of asbestos-containing material from the working area. "Stack effect" of the shafts, stairwells, etc., shall be considered satisfactory only if visible insulating material cannot escape from the enclosure.

3. Wet asbestos-containing material which has fallen to the floor shall be swept up continuously to prevent dispersal of dried material. Under no condition shall this material be removed later than at the end of the working day. Swept-up material shall be placed in a heavy plastic bag strong enough to resist tearing or breaking under normal handling conditions and clearly marked as containing asbestos waste. The contents of the aforementioned plastic bags shall not be transferred to another container. The plastic bags shall be placed upon a vehicle for disposal at an approved site.

4. All floors will be vacuumed shortly after drying. The vacuum cleaner shall contain a strong, single-service disposable inner bag of durable material which shall be removed, then be placed in a container of the type described in paragraph 3, which shall thereafter be placed on a vehicle for removal and disposal at an approved site.

5. The materials used to form the enclosure shall be thoroughly vacuumed upon completion of the application of the insulation in the area. The entire floor area, all ledges and surfaces including tarpaulins upon which waste insulation material may have fallen, shall then be vacuumed or revacuumed before removal of the enclosures.

6. Enclosures shall not be dismantled until the area has been thoroughly vacuumed after completion of spraying and cleanup.

7. All areas used for opening bags containing asbestos insulating material and/or charging of hoppers shall be enclosed in such a manner that asbestos-containing insulating material shall not be permitted to escape from the immediate area in which such activity takes place.

8. Signs shall be posted outside enclosures warning persons of the hazards of entering the enclosure without appropriate mask and other apparel.

9. All persons involved in the spraying of asbestos at the site must be furnished with Bureau of Mines approved respirators for pneumoconiosis-producing dust or equipment as required by N.Y. State Department of Labor and must be furnished with suitable coveralls which will be left at the site and thereby preclude the removal of asbestos from the site. No person shall be permitted in an area in which asbestos spraying or handling has taken place until final vacuuming referred to in paragraph numbered "5" herein, unless such person is furnished with and wears a Bureau of Mines approved respirator for pneumoconiosis-producing dust and coveralls of the type described herein. Facilities shall be provided and procedures instituted and supervised that preclude the removal and dispersal of asbestos-containing material from the construction site on the clothing or other appurtenances of persons leaving the area.

10. Any plenum or other structures coated with asbestos-containing insulation which is intended for use in the circulation of air in the building must be thoroughly cleaned of all debris and waste insulation. All applied asbestos-containing insulation within a plenum or duct must be coated with a sealant which precludes exposure of the asbestos-containing material to the circulating air.

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11. A person shall be assigned the full-time responsibility to supervise the spraying and related operations to assure that no asbestos-bearing material is released from the construction site.

12. In case of emission of asbestos from the construction site, immediate steps shall be taken to cause the cessation of such emissions by either effective control measures or work stoppage at the source of the emissions. There shall then be immediate and complete cleanup of all material that has escaped the construction site by measures that will insure that no further dispersal of any asbestos material into the atmosphere can occur.

13. Notice of intent to spray asbestos-containing material on any premises shall be given to the director of Field Services, Department of Air Resources, 134 Centre Street, New York, N.Y. (212-566-2735). Said notice shall be both oral, by telephone, and in writing and shall specify, at least two (2) days prior to said spraying, the floors on which the spraying will take place.

It will be seen that these early regulations (they have since been strengthened) were directed largely to the prevention of the environmental hazard. In addition, we were able to identify a number of other approaches which were more specifically concerned with the occupational hazard.

Reduction of Airborne Asbestos during Spray Operations

Currently, consideration is being given within the industry to several proposals aimed at reducing the amount of asbestos dust which might become airborne during spraying.

An important approach includes elimination of asbestos from the material used and the selection of oils or wetting agents. Formulation changes have met with some success. Several manufacturers are now producing material which contains no asbestos. The disease potential of these substitute materials is largely unknown, and New York City regulations require the same precautions during their application, as with asbestos-containing materials.

In Great Britain, the modification of spray equipment has received considerable attention. A method of prewetting the fiber before conveying material to the nozzle has been developed. Although this prewetting process significantly reduces fiber counts during applications, the method does not yet lend itself to volume spraying as done in the United States.

Progress has been made in developing effective means of enclosing areas during spray application (Figures 5 to 10). Several contractors have custom-designed canvas or reinforced plastic tarpaulins with various flaps and interlocking closure devices. Wooden frames covered with reinforced plastic are in use. Not only must the perimeter be enclosed, but the stairwells and elevator shafts must be sealed to prevent the stack effect from carrying dust and fiber to the outside atmosphere. Some rather unique ways have been developed for enclosing outside spandrels and columns prior to spraying. Since the design of buildings may differ widely, methods for enclosing must be individually tailored for a particular structure. To eliminate the need for temporary enclosure of buildings, some contractors are rescheduling the spray application to permit prior erection of curtain walls and glazing of the window openings.

Enclosure with canvas and plastic has markedly improved since enactment of more stringent regulations. Ambient air samples taken near spray job sites that have been enclosed by means of newer methods have shown that excellent containment is possible. Asbestos fiber emissions from properly enclosed spray operations were not detected with the light microscope. Electron microscope examination of samples is currently under way to determine if the spray process adds significantly to the asbestos fiber background level in ambient air. In limited studies, it did not. Enclosure taping, however, still has not solved the problem of wind erosion during the interval between com-