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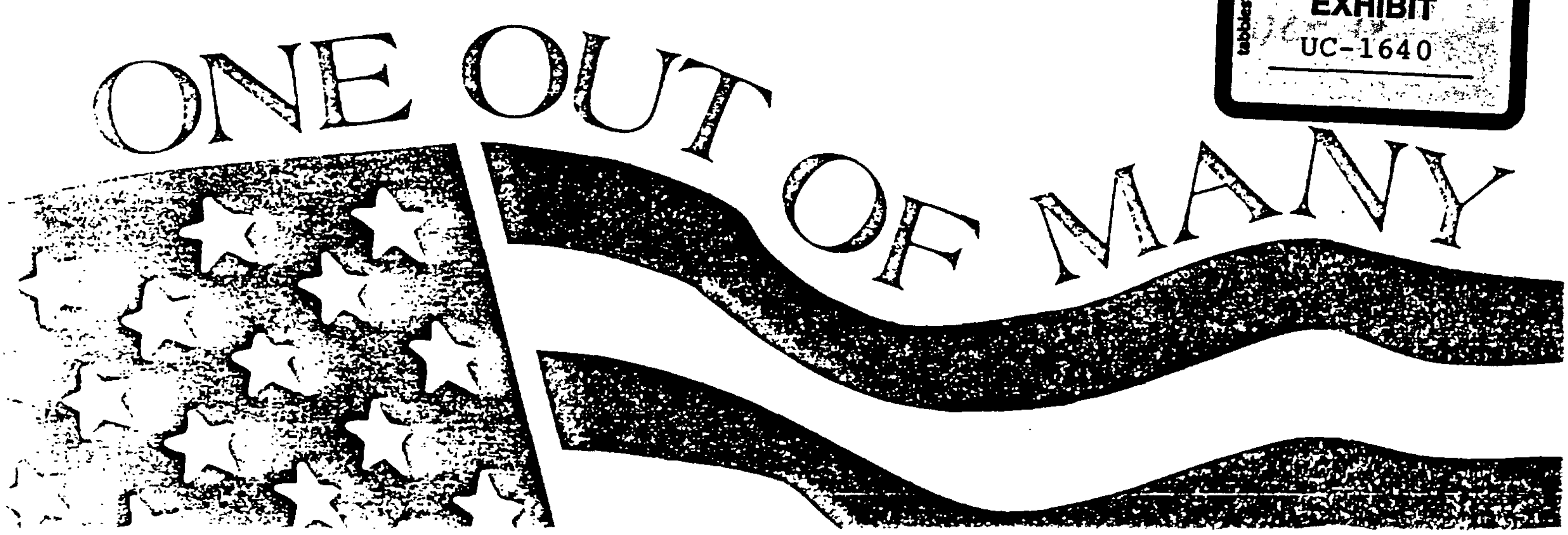

ASBESTOS AND SILICA DUST
in the Drywall Industry. Business-Health-Life Part 2

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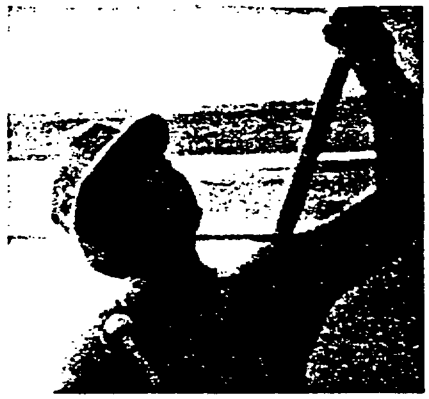
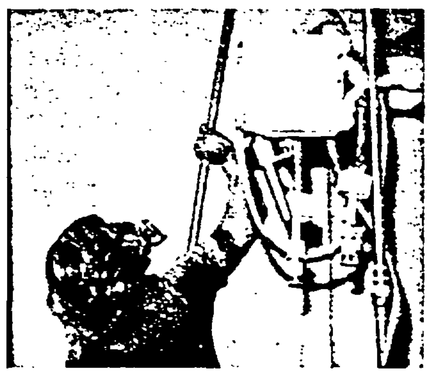




Introduction

In the last issue of the GDCI Drywall Magazine, the current status of the OSHA regulations for asbestos and for crystalline silica was described. This article completes the picture with field data on asbestos and silica exposure under normal operating conditions obtained at eight job sites in four states. Sanding, wet-out of dry-mix materials, and cleanup were examined. Work procedures at the jobs tested are described so that the results can be related to similar operations in other locations.

Abstract

The highest airborne asbestos concentration found during sanding was 3.5 fibers/cc longer than 5 micrometers. This is well below the allowable OSHA ceiling limit of 10 fibers/cc. The corresponding 8-hour, time-weighted average exposures ranged from 0.2 to 0.9 fibers/cc. These levels are also well below the 5 fiber/cc limit now allowed and the 2 fiber/cc limit scheduled to go into effect in mid 1976.

Asbestos exposure during the wet-out of dry-mix materials ranged from 2.7 to 62 fibers/cc. It appears to be possible to hold the concentration to acceptable levels by careful handling of the bags but it is probably desirable to wear an approved respirator during this operation.

The concentrations of respirable dust generated by three different dry sanding procedures varied by a factor of ten. The contractor has a great deal of control over dust levels on the job by his choice of work practices.

Exposure to airborne quartz was checked at five job sites and three were found to be near or above the Action Level proposed by NIOSH. The observed levels depended directly on the quartz content of the mud and on the severity of the sanding operation. Much higher levels are possible under adverse combinations of these two factors.

The Choice for the Drywall Industry

The information presented here provides an excellent illustration of a broader question that is facing industry today, i.e., what is the best way to comply with the various occupational safety, consumer safety, and environmental protection regulations that are being promulgated? These safety and health regulations are an established trend of the times and appear to be here to stay. By their very nature, these regulations generally increase the cost of each product and service involved. Although these costs will ultimately be borne by the final user, it benefits everyone to achieve the appropriate level of safety and health in the most efficient way possible and thus minimize the incremental cost for these important items.

When a new regulation is promulgated covering a particular material, the natural reaction is to put the entire burden on the supplier and demand that he replace

A07977

the regulated ingredient. In the case of asbestos, which imparts very valuable performance characteristics to the tape joint compounds, the replacement is proving to be difficult. The asbestos-free muds so far available are more expensive. Also, they often do not trowel as well which adds to the cost of installation. Additional reformulation to reduce the quartz level could result in further loss in properties and increases in cost.

It will be shown that the dust levels related to drywall finishing vary widely depending on how the contractor operates. This suggests that it may be to the contractor's advantage to make reasonable adjustments in operating procedures to use existing products in compliance with regulations rather than demanding that the suppliers provide products that are completely safe under the most adverse job-site conditions but are more expensive and do not perform as well.

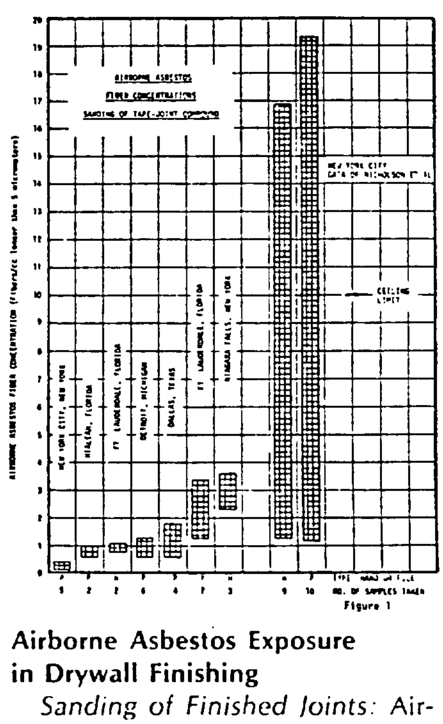
Collection of Dust Samples

The photographs on the cover of the November-December issue of Drywall Magazine showed how the air samples were collected. Both personal samples and high-volume area samples were obtained. For personal samples, a small battery-driven vacuum pump was hooked to the operator's belt. A cartridge containing a filter paper about one and one-half inches in diameter was attached to the operator's shirt pocket and connected to the pump with plastic tubing. As the man went about his job in the normal manner, air from his breathing zone was drawn through the filter paper by the vacuum pump so that the dust present in the air sample was deposited on the filter paper.

The high-volume samplers operated the same way but were larger and pulled about five times as much air. They were mounted on poles adjacent to the sanding and were moved at regular intervals to stay close to the operator.

There was one important difference in the samples collected for silica analysis. The proposed regulations refer to the "respirable fraction" of the total dust. This fraction is made up of the smaller, lighter particles in the total dust which are considered most likely to be carried into the lungs during breathing. A small cyclone separator was used ahead of the filter for these samples to remove the heavier dust particles and leave only the respirable dust.

For the asbestos measurements, the filter paper was examined under a microscope and the number of fibers longer than 5 micrometers (µm) was counted. For silica, the total quantity of sample collected was weighed and the percent quartz was found by X-ray diffraction. All procedures used were in accordance with OSHA regulations for asbestos or NIOSH recommendations for crystalline silica.[1]



Airborne Asbestos Exposure in Drywall Finishing

Sanding of Finished Joints: Airborne asbestos fiber concentrations during routine sanding operations were measured at six locations in four states. The results are shown in Figure 1 together with the data reported by Nicholson et al[2]. The range of fiber concentration measured at each location is given by the cross-hatched bars. The type of sanding, hand or pole, and the total number of personal samples taken at each job location are shown at the bottom of the Figure.

It is immediately evident that the samples collected in this survey are much lower than those reported by Nicholson. When this gross difference became evident, two filters each from three different locations were sent to independent laboratories for check counts. The results are compared with those of the Union Carbide laboratory in the following table:

Interlaboratory Comparison
Asbestos Fiber Counts

Sample Source	Airborne Asbestos Fiber Concentration (Fibers/cc longer than 5µm) By UCC	By Lab A	By Lab B
Location I (Filter #1)	0.4	0.3	0.2
Location I (Filter #2)	0.4	0.0	0.2
Location II (Filter #1)	1.5	1.0	1.6
Location II (Filter #2)	1.3	1.0	0.6
Location III (Filter #1)	0.6	0.0	0.9
Location III (Filter #2)	0.4	0.2	0.2

Although there is some variation, these are difficult samples to count and the agreement between laboratories is excellent. It is evident that the differences between this survey and that of Nicholson are not due to sample analysis. The sanding procedures used to generate seem to be the most likely cause. In any case, the Nicholson results do not appear to be typical of the concentrations encountered under most job-site working conditions.

[1] The authors wish to express their thanks to the NGC Environmental Laboratories, Gold Bond Building Products, Division of National Gypsum Company, Buffalo, New York, who provided the collection equipment and analyzed the silica samples.

[2] Paper presented by Dr. W. J. Nicholson at the Miami, Florida meeting of the American Industrial Hygiene Association Conference, May 12-17, 1974.

A07978

The ceiling limit allowed under the present OSHA asbestos regulations is also indicated in Figure 1. This limit is the highest level to which a worker may be exposed at any time without protective equipment. It is evident that the asbestos concentration in the seven jobs checked in this survey were all well below the 10 fibers/cc limit.

The OSHA regulations also specify a maximum allowable time-weighted average exposure of 5 fibers/cc now and a reduced level of 2 fibers/cc in July 1976. The Time-Weighted Average (TWA) is a measure of the workers' average exposure during the entire 8-hour workday. This concept is particularly important to the tape joint industry where asbestos exposures generally occur only during a moderate portion of some working days. As an example of Time-Weighted Average, a man might sand for two hours at an exposure level of 4 fibers/cc and work at some other job for the rest of the shift at another location where there is no asbestos present so the exposure would be essentially zero. In this case, his Time-Weighted Average would be calculated as:

$$\text{TWA} = \frac{(4\ \text{fibers/cc}) \times (2\ \text{hours}) + (0\ \text{fibers/cc}) \times (6\ \text{hours})}{(2\ \text{hours}) + (6\ \text{hours})} =$$

$$\frac{(4) \times (2) + (0) \times (6)}{6 + 2} = \frac{8 + 0}{8} = 1\ \text{fiber/cc}$$

Time-Weighted Average exposures have been estimated in the manner shown above for the seven job operations in Figure 1. The results are listed in the following table:

Summary of Airborne Asbestos Fiber Concentrations During Drywall Sanding

Location	Ceiling Exposure (Fibers/cc >5μm)	Exposure Time During Sanding (Hours)	Estimated 8-Hour TWA Exposure (Fibers/cc >5μm)
New York City, NY	0.4	8.0	0.3
Hialeah, FL	1.0	4.0	0.4
Ft. Lauderdale, FL (Hand)	1.1	1.0	0.1
Detroit, MI	1.3	8.0	0.9
Dallas, TX	1.8	0.5	0.1
Ft. Lauderdale, FL (Pole)	3.4	3.3	0.6
Niagara Falls, NY	3.6	0.6	0.2

The estimated TWA values range from 0.9 fiber/cc down to 0.1 fiber/cc. They are all well below the current 5 fiber limit and the July 1976 2 fiber/cc limit. While it is recognized that this is only a small sample from the hundreds of locations throughout the country where tape joints are sanded, the sanding procedures used were typical of most commercial situations. The results provide good evidence that the asbestos concentrations during sanding at most locations are generally below the allowable OSHA limits.

Wet-Out of Dry-Mix Materials: In some parts of the country, dry-mix tape joint compounds and texture sprays containing asbestos are widely used. When these are mixed into water at the job site, asbestos exposure can result. Spray texture paints may contain about the same level of chrysotile asbestos as tape joint compounds.

Asbestos exposure during the wet-out of wall and ceiling spray texture was measured at two locations. In Figure 2 the results are compared with those of Nicholson for the wet-out of tape joint compounds. Since these are short-term occasional exposures, the ceiling limit of 10 fibers/cc is most pertinent and is also shown on the Figure.

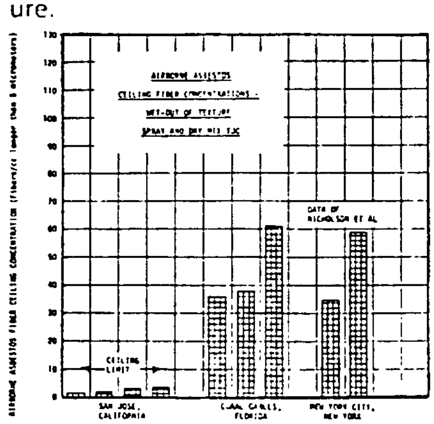


Figure 2

It is clear that the fiber counts vary widely and are also frequently well above the 10 fiber/cc limit. In the San Jose test where the bags were emptied slowly and carefully, the levels were low. At the other location where the bags were emptied rapidly and shaken in a closed truck the fiber concentrations were in the same range as the high levels reported by Nicholson. On the basis of this data, it is prudent to wear a respirator while wetting out dry-mix and the bags should also be handled with care.

Cleanup After Job Completion: Asbestos exposure may also occur during the cleanup after a drywall finishing job is completed. Limited data on this operation are shown in Figure 3, together with the results reported by Nicholson.

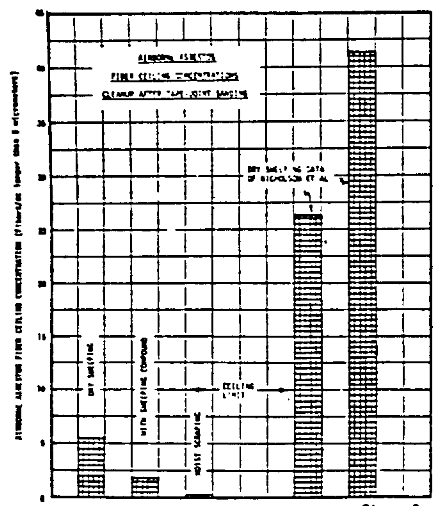


Figure 3

In the left-hand portion of the Figure are data obtained in a test at a Florida condominium. Both the walls and ceilings had been sanded lightly and then sprayed with texture paint. The texturing overspray had hardened on the floor. The normal cleanup procedure was to wet the floor lightly with water from a hand sprayer and then remove all excess material from the floor with a long-handled scraper. As might be expected, this damp operation gave a very low airborne fiber concentration of 0.3 fiber/cc.

In order to get a direct comparison with other cleanup methods, a number of apartments in the same building were swept with a stiff broom, both with and without the addition of ordinary sweeping compound. It was difficult to break loose the hardened overspray so the broom work was fairly vigorous. In spite of this, the highest level

A07979

found was a ceiling concentration of 5.5 fibers/cc produced by the dry sweeping. Use of the sweeping compound reduced this to 1.8 fibers/cc.

These data illustrate that moist scraping, which is now in regular commercial use in some parts of the country, is a good cleanup method to control dust. These data do not mean there is no asbestos dust problem during cleanup since jobs where the walls have been sanded heavily present more potential for dust generation than the light sanding case tested. This point is emphasized by the data of Nicholson in Figure 3 which gave levels of 26 and 43 fibers/cc during sweeping after heavy sanding. While it seems doubtful that levels this high would be encountered in most typical job cleanup situations, exposures above the ceiling limit appear quite possible. More information is needed to define better the levels to be expected under routine field conditions.

Airborne Respirable Dust Exposure in Drywall Sanding

It was noted in the first article that there is an OSHA standard which sets the maximum allowable exposure level to the respirable fraction of nuisance dust at 5 milligrams per cubic meter (mg/M^3) of air. In simplest terms, a nuisance dust is a dust which does not have the exposure level controlled by any of the other standards for specific materials. Even if a dust containing asbestos and/or crystalline silica is in compliance with the standards for these materials, it would still be in violation if the respirable dust level exceeds 5 mg/M^3.

The concentration of respirable dust during sanding was measured at five of the job sites in three states. These levels, expressed as milligrams of respirable dust per cubic meter of air, are shown in Figure 4. The crosshatched bars give the range of concentrations found at each job with the respective average concentrations shown by the dark line in the central portion of each bar. Sanding conditions for each site are also noted.

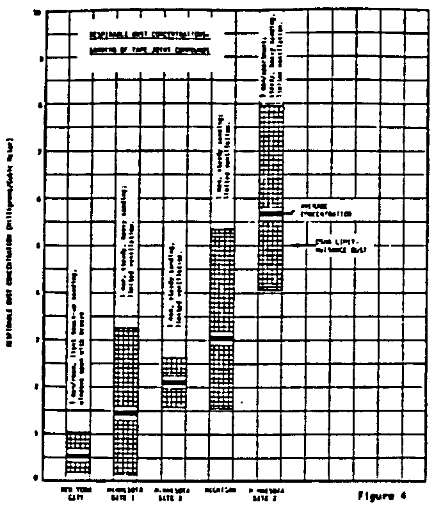


Figure 4

At the New York location, two courses of general-purpose, ready-mix mud had been applied with hand tools. The building was a high-rise apartment with the windows open and a light breeze blowing. A five-man crew of tapers was spot sanding lightly by hand or with a pole sander as needed and touching up with a finish coat of general-purpose, ready-mix. Usually only one man was working in each room. Respirable dust levels from personal samplers ranged from 0.2 to 1 milligram per cubic meter and averaged a very low 0.55 mg/M^3.

The Michigan test took place at a multilevel dwelling (approximately 2,300 square feet floor area) finished with a dry-mix topping compound. The windows were closed and there was no ventilation. A laborer, who normally spends most of his time sanding, went over the walls and ceiling in about four hours with a pole sander. Respirable dust ranged from 1.55 to 5.34 mg/M^3 and averaged 3.02 mg/M^3.

The tests at Minnesota Site 1 and Site 3 were quite similar to that in Michigan. Both were residential dwellings of 2500 and 1500 square feet, respectively, finished by hand tools with asbestos-free dry-mix topping compound and pole sanded in about four hours by a laborer who did this as a full-time job. The windows were in and there was little ventilation. At the smaller house, Site 3, only the walls were sanded. Respirable dust at Site 1 ranged from 0.15 to 3.23 mg/M^3 and averaged 1.45 mg/M^3. At Site 3 the range was narrower at 1.59 to 2.62 mg/M^3 but averaged about the same at 2.10 mg/M^3.

Minnesota Site 2 was a four-story apartment building with an asbestos-free dry-mix topping compound finished with hand tools. There was very limited ventilation while three men sanded together in each apartment unit until it was finished and then moved on to the next unit. Here the range fell in the much higher level of 4.06 to 7.95 mg/M^3 and the average was 5.76 mg/M^3. This was the only location where the respirable dust level consistently exceeded the OSHA limit.

These data show clearly that there can be a very wide, tenfold, difference in the average respirable dust levels for the different severities of sanding. Light, touch-up sanding with good ventilation gave about 0.5 mg/M^3. The three tests with one man sanding steadily with little ventilation ranged from 1.5 to 3 mg/M^3 and averaged 2.1 mg/M^3; about four times that for touch-up. Three men sanding together increased the average level to about 2.5 times that of one man sanding alone and 10 times that of touch-up. It is very clear that the dust level at the job site can be changed widely by the work practices employed.

Airborne Crystalline Silica (Quartz) Exposure in Drywall Sanding

The airborne quartz concentration in the dust generated during the sanding of tape joint compound was measured at five job sites in three states. The concentrations

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found, expressed in micrograms per cubic meter, are shown in Figure 5. A microgram (μg) is 1/1000 of a milligram so these levels are much lower than the respirable dust. The maximum allowable TWA and Action Level proposed by NIOSH, the quartz content of each mud, and the average level of respirable dust measured at each job location are also given.

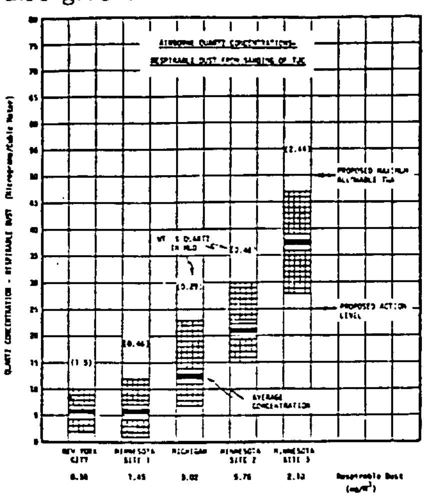

Figure 5

Two locations, Minnesota Sites 2 and 3, had quartz concentrations that were above the proposed action level, and a third, Michigan, approached this level. The other two jobs tested, New York and Minnesota Site 1 had very low quartz levels and were well below the Action Level. Three out of five of these job sites thus had concentrations high enough so that regular monitoring would probably be required under the proposed regulations.

The results for Minnesota Site 2 are of particular significance. Here three men sanded together in each apartment and generated the highest observed respirable dust level of 5.66 mg/M³ but the quartz level was not the highest found by a considerable margin. The mud being sanded had a low quartz content so the dust generated also contained less quartz.

This point is shown more specifically by a direct comparison of the New York and Minnesota Site 2 results. The mud used in New York contained about three times as much quartz as that used in Minnesota. The sanding was lighter in New York, however, and only about one third as much dust was generated. These opposing factors balanced out to give the same quartz level at both locations. A mud with a high-quartz level, sanded lightly, can thus give the same airborne quartz concentration as a low-quartz mud sanded heavily.

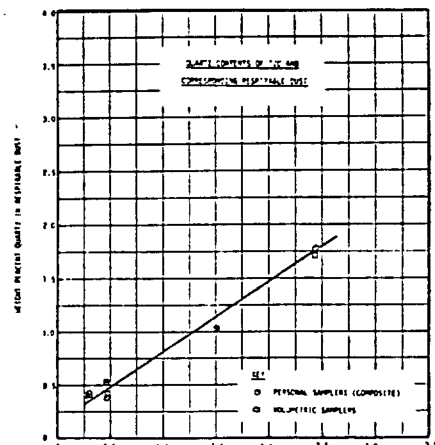

Figure 6

The broader applicability of this principle is illustrated in Figure 6 which compares the concentration of quartz in the respirable dust with the concentration of quartz in the mud being sanded. Over the range of mud concentrations tested, these two concentrations are approximately equal. On this basis, a mud containing 2.5% quartz sanded at the most severe conditions like Minnesota Site 2 could give a quartz concentration around 100μg/M³, far above the allowable level.

It was shown in the first article that the eleven commercial muds tested had quartz levels ranging from 0.3 to 2.5%. The tape joint industry thus appears to be facing a range of conditions. Light sanding of low, and even medium, silica muds should give quartz concentrations well below the proposed Action Level. Heavy sanding of high-quartz muds is likely to give concentrations well over the allowable limit. The whole range of quartz concentration in between is possible depending on the kind of mud used and the sanding procedures followed.

Summary and Conclusions

The exposure to airborne asbestos during the sanding of tape joint compound was measured under routine working conditions at seven job sites in four states. A wide variety of sanding conditions was tested. Exposure to respirable dust and crystalline silica (quartz) was also measured at most of these sites.

The airborne asbestos ceiling concentration found at each of the sites ranged from 0.4 to 3.6 fibers/cc longer than 5 micrometers compared with an allowable level of 10 fibers/cc longer than 5 micrometers. Time-Weighted Average exposures were also calculated for each job and were found to vary from 0.2 to 0.9 fibers/cc longer than 5 micrometers. These levels are well below both the OSHA limit of 5 fibers/cc now allowed and the 2 fibers/cc level scheduled to go into effect in mid 1976.

Asbestos exposure during the wet-out of dry-mix tape joint compounds and spray-texture paint was examined. Ceiling exposures for this short-duration operation ranged from 2.7 to 62 fibers/cc longer than 5 micrometers. It is possible to keep the concentrations at acceptable levels by careful handling of the bags, but it is probably desirable and may be necessary to wear an approved respirator during this operation. The substitution of ready-mix is also an obvious possibility.

Cleanup procedures after completion of drywall operations were tested briefly. Both high and low asbestos dust levels appear to be possible, depending on the amount and type of sanding done and the type of sweeping. A very effective wet-spray and scraping cleanup method now in general use in some

A07981

parts of the country was demonstrated.

The concentrations of respirable dust generated by light touch-up sanding, by continuous sanding by one man, and by continuous sanding by three men were compared and found to vary by a factor of about ten. The highest concentrations found were above the OSHA limit for nuisance dust.

The quartz content of eleven commercial muds was found to vary from 0.3 to 2.5%. The quartz content of the common raw materials used in the manufacture of tape joint compounds suggests that a completely quartz-free mud may be difficult to attain.

Exposure to airborne sanding dust containing crystalline silica (quartz) was found to range from 2 to 47 micrograms of quartz per cubic meter of air sampled. Three of the five locations tested gave levels above or close to the NIOSH proposed Action Level of 25 micrograms per cubic meter. The airborne quartz level depended directly on the quartz content of the mud and on the severity of sanding. It could be much higher than 47 mg/M³ under readily attainable conditions. At these levels, the proposed OSHA regulations on crystalline silica would require monitoring and other precautions similar to the present asbestos regulations.

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