HETA 87-008-1794
APRIL 1987
DESIGN DRYWALL SPECIALTIES, INC.
DENVER, COLORADO

NIOSH INVESTIGATORS:
William Daniels, CIH
Bobby Gunter, Ph.D, CIH
Thomas Wilcox, M.D.

I. On October 9, 1986, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate possible organotin exposures among drywall finishers employed by Design Drywall Specialties, Inc., Denver, Colorado, who had worked with a particular batch of drywall joint compound. Testing conducted by the local health department had revealed the presence of an unusually large amount of organotin in samples of the compound. Employees working with this material complained of headaches, skin irritation and respiratory problems.

On October 14, 1986, NIOSH investigators conducted an initial survey. Information provided to the investigators indicated that excess preservative material was inadvertently added to a batch of the joint compound during its formulation by the manufacturer. The batch of the joint compound in question reportedly had been used by these employees during the week of September 15, 1986.

On October 15, 1986, NIOSH investigators collected airborne and bulk samples for total tin and organotin analysis. No organotin was detected above the limit of detection of 0.2 micrograms (ug) on either filter or charcoal tube air samples collected in the house. It should be noted that the sampling took place approximately one month after the reported use of the material.

A comparison of the results of bulk samples taken from boxes of the joint compound identified by the requester as "contaminated" and "normal" revealed concentrations of organotin of 1800 ug/gram (ug/g) and 11 ug/g respectively, and total tin concentrations of 2100 ug/g and less than the limit of detection of 300 micrograms, respectively. Samples of dried joint compound taken from two locations within the house revealed concentrations of 780 and 770 ug/g organotin, and concentrations of total tin of 860 ug/g in one sample and less than 300 ug/g in the second sample.

On February 24-25, 1987, medical interviews were conducted with three of the workers who had used the drywall compound in question, as well as an occupational health physician who had seen four of the employees. Symptoms reported by these three indiviuals, who had used the material at different locations, included; severe headache, nausea, cough, eye and throat irritation. To date, the three workers have been unable to return to work due to severe headaches and fatigue. The affected workers have undergone a comprehensive medical evaluation that has documented the presence and progression of symptoms, but has not detected any abnormal physical signs.

Although there is insufficient data to allow the NIOSH investigators to establish a definite correlation between the employee exposures and the reported health problems, on the bases of; 1) the presence of unusually high levels of organotin (and possibly other preservative agents) in the joint compound, 2) the consistency of the reported symptoms with the known acute effects of exposure to the components of the joint compound, and 3) the onset of similar symptoms in workers working with the same batch of material at three different worksites, it appears likely that one or more of the constituents of the joint compound were related to the appearance of symptoms in the affected workers. However, since the specific etiology of the workers symptom is still unclear, recommendations are contained in this report to encourage the collection of additional data related to this investigation.

KEY WORDS: SIC 1742 (Plastering, Drywall), drywall finishing, joint compound, organotin, bis(tri-n-butyltin) oxide, 2[(hydroxymethyl)amino]-ethanol, methanol, hexylene glycol, headache, fatigue, irritation.

## II. INTRODUCTION

On October 9, 1986, a representative of Design Drywall Specialties, Inc., Denver, Colorado, requested that NIOSH conduct a health hazard evaluation of potential organotin exposures among company employees engaged in drywall finishing. The request was a result of employee complaints of headaches, skin irritation and respiratory problems while working with a particular batch of drywall compound. The request indicated that prior testing conducted by the local health department had revealed the presence of unusually high levels of organotin in the joint compound being used at this location.

On October 14, 1986, NIOSH investigators met with representatives of Design Drywall Specialties, Inc. and a representative from the local distributor of the joint compound. On October 15, 1986, NIOSH investigators collected airborne and bulk samples for total tin and organotin analysis in one of the homes where the material had been used. On February 24-25, 1987, a NIOSH medical officer conducted interviews with three workers involved who had worked with the batch of joint compound in question, as well as met with an occupational health physician who the workers had seen.

## III. BACKGROUND

Design Drywall Specialties, Inc. is engaged in the installation and finishing of drywall in homes and commercial properties. Following hanging of drywall, a joint compound is used by drywall finishers to tape over the joints between the various sections of the drywall. Repairmen then patch any areas needing further work.

A review of the material safety data sheets for the joint compound used by the drywall finishers, "Ready Mix Joint Compound" (Gold Bond Building Products, Division of National Gypsum), revealed its contents to be: calcium carbonate, mica, talc, quartz (present as a natural occurring constituent), and a non-mercurial preservative (Troysan 364 and Troysan 174). Review of the material safety data sheets for Troysan 364 indicated the following composition; 2[(hydroxymethyl)amino] ethanol (21%), bis(tributyltin) oxide (29%), methanol (16%), and hexylene glycol (31%), with Troysan 174 being composed entirely of 2[(hydroxymethyl)amino] ethanol.

During the initial survey, information provided to the NIOSH investigators indicated that an unusually large amount of the preservative material was inadvertently added to a batch of the joint compound during its formulation. The company representatives indicated that the employees who had worked in the house applying this batch of joint compound had complained of severe headaches, skin irritation, and respiratory problems. As a result, these employees were sent to see a local occupational health physician for evaluation.

## IV. MATERIALS AND METHODS

### A. Environmental

During the initial survey of October 14, 1986, NIOSH investigators collected background information on the nature of the request, as well as information related to the materials used in the joint compound. Since the original incident had reportedly occurred during the week of September 15, 1986, one month prior to the NIOSH survey visit, it was not possible to document the employee exposures that may have occurred during the actual application of the joint compound. However, since there was a concern expressed over the possibility of residual exposure levels in one of the the homes where the material had been used, it was determined that air and bulk samples would be collected to assess the nature and extent of the organotin levels which would still be present.

On October 15, 1986, NIOSH investigators collected environmental samples at the house in question. This included the collection of 6 general area air samples and 4 bulk material samples of the drywall joint compound. Air samples were collected over approximately 300 minute periods using battery-powered portable sampling pumps operating at flow rates ranging from 0.85 to 1.8 liters per minute. The collection media consisted of 37 millimeter mixed-cellulose ester membrane filters (0.8 micrometer pore size), with two of the filters having a 400/200 milligram activated charcoal tube in-line following the filter. Samples were collected at various locations on the first and second floors of the house. During the sampling period, windows and doors in the house were closed. A listing of pertinent information related to air sample collection is provided in Table 1.

In addition to the air samples, bulk material samples of the drywall compound were also obtained. These consisted of samples collected from two unused boxes of the joint compound identified by the requester as "normal" and "contaminated", as well as the collection of samples of the dried joint compound from two separate locations on walls within the residence. A listing of pertinent information related to bulk sample collection is provided in Table 2.

Due to the length of time between the actual application of the material and the environmental survey, no samples were collected for the more volatile components of the joint compound.

All samples were shipped via overnight mail to a NIOSH contract laboratory, Utah Biomedical Test Laboratory, Salt Lake City, Utah for analysis. Bulk material samples were analyzed for both total tin and organotin. Air samples were analyzed only for organotin.

Sample analysis for total tin was conducted by atomic absorption spectroscopy (AA). The samples were ashed with sulfuric and nitric acids and diluted to 25 milliliters. The analysis were then completed according to NIOSH Method P&CAM 368 using appropriate dilutions and spikes. The best spike recovery achieved was 27%. The samples were then analyzed by flame AA which gave a spike recovery of 106%. The reported results are those from the flame analysis.

Samples for organotin were analyzed by graphite furnace atomic absorption spectroscopy. Sample

preparation included extraction with 10 milliliters acetonitrile, 10 microliters acetic acid, and sonicating for thirty minutes. The analyses were then completed according to NIOSH Method 5504.

B. Medical

On February 24-25, 1987, a medical site visit was conducted during which three of the employees who had worked with the "contaminated" batch of the drywall joint compound were interviewed. These employees were questioned as to the nature and extent of any health problems which they experienced, as well as asked to give a brief description of the circumstances surrounding their work with the compound. In addition, the clinical course of the workers was discussed with an occupational health physician whom the four employees had seen.

## V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations [Recommended Exposure Limits or REL's], 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) [Threshold Limit Values or TLV's], and 3) the U.S. Department of Labor (OSHA) occupational health standards [Permissible Exposure Limits or PEL's]. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information that are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is

required by the Occupational Safety and Health Act of 1970 (29 USC 65l, et seq.) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Since there were several different components contained in the preservative used in the drywall compound, a general discussion of the toxicity of each of these materials is provided below. The environmental criteria for each of these substances is also included.

1) Organotins and Bis(tri-n-butyltin) oxide

Bis(tri-n-butyltin) oxide (TBTO) is a member of the organotin family of compounds having at least one covalent carbon-tin bond. There are many members included in this family, and the toxicity of these compounds varies widely.[1] In general, animal studies indicate a higher order of toxicity for trialkyltins than for their monoalkyltin and dialkyltin counterparts.[2] However, from the standpoint of mammalian toxicity, bis(tri-n-butyltin) oxide appears to be one of the less toxic members of the group of alkyl tin compounds.[1] Acute and subacute studies in rats, rabbits, and guinea pigs revealed bis(tri-n-butyltin) oxide to be moderately toxic.[1]

Tributyltin compounds are considered to be primary skin irritants capable of penetrating intact skin and can cause sensitization and skin lesions.[1] In an outbreak of dermatitis among painters exposed to paints containing TBTO, ocular and respiratory irritation were described as well.[3] In humans, irritation of the eyes and respiratory tract have been reported at concentrations of bis(tri-n-butyltin) oxide at or near 0.1 milligrams per cubic meter ($mg/M^3$) as tin.[2]

Neurotoxic effects from organotin compounds have been noted since the 1950s, when a French dermatological medication called Stalinon was found to include triethyltin iodide as a contaminant and was the major cause of 200 illnesses with 50% mortality. Central nervous system symptoms included headache, nausea and vomiting, disturbances of consciousness and psychological disorders, and visual symptoms.[4] In a more recent report, an accidental spill and poor hygienic conditions were found to have led to occupational exposures to di- and trimethyl tin dichloride, and nonspecific symptoms of organic brain syndrome.[5] Two studies in rats showed no central nervous system damage when fed lethal doses of bis(tri-n-butyltin) oxide.[2] A separate study, however, did reveal significant lowering of noradrenaline and 5-hydroxytryptamine levels in the brain of rats administered lethal doses of bis(tri-n-butyltin) oxide; however, no definite correlation between the toxicity of the organotin and its effects on the tissue amine levels was established.[6]

Although not reported in human exposure incidents, effects on the kidneys have been

observed in animal studies. TBTO painted on guinea pig skin induced a secondary Fanconi syndrome.[7]

A literature search failed to identify any reports linking organotin exposure and cancer, either in animals or in humans. Organotin compounds are not listed in lists of carcinogens compiled by the International Agency for Research on Cancer, the National Toxicology Program, the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, or the American Conference of Governmental Industrial Hygienists.[8]

The NIOSH REL, OSHA PEL, and ACGIH TLV for organotin compounds are currently 0.1 mg/M$^3$, as tin.[9,10] The ACGIH also gives these compounds a "Skin" notation indicating that either airborne or more particularly, direct contact with the skin or mucous membranes of the eyes can further contribute to the overall exposure.[10]

2) Methyl Alcohol

Direct skin contact with methyl alcohol may cause dermatitis, erythema, and scaling. Inhalation of high concentrations may produce headache, weakness, drowsiness, lightheadedness, nausea, vomiting, drunkenness, and irritation of the eyes. Exposure to very high concentrations of methyl alcohol has been reported to cause death or blindness, usually from working in a confined spaces.[11] The NIOSH REL, OSHA PEL, and ACGIH TLV for methyl alcohol are currently 200 ppm on a TWA basis.[9,10] NIOSH recommends, also, a ceiling concentration not to exceed 800 ppm for a 15-minute sampling period, and the ACGIH recommends a short-term exposure limit of 250 ppm, with a "Skin" notation.[9,10]

3) 2-[(Hydroxymethyl)amino]ethanol

Very little information was found in the literature regarding the toxicity of this compound. One available study which was reviewed involved dermatitis among paperhangers.[12] In this study, 2-[(Hydroxymethyl)amino]ethanol was one of three ingredients in the wallpaper paste used by the employees which proved positive in patch testing conducted on the affected workers.[12] There are presently no occupational standards or criteria for airborne exposure to this substance.

4) Hexylene Glycol

Application of hexylene glycol to the skin can result in mild to moderate irritation, and it does not appear to be absorbed through the skin. Concentrations of 50 ppm for 15 minutes have been observed to cause slight eye irritation, with concentrations of 100 ppm for 5 minutes causing slight nasal and respiratory discomfort, and 1000 ppm for 5 minutes causing irritation of the eyes and throat and respiratory discomfort.[1] The ACGIH TLV is a ceiling limit of 25 ppm designed to prevent eye irritation.[10]

## VI. RESULTS

### A. Environmental

The results of the air sample analysis are presented in Table 1. As evidenced from these data, no organotin was found on either the filter samples or charcoal tubes above the limit of detection of 0.2 micrograms per sample.

The results of the bulk sample analysis are given in Table 2. As evidenced from these data, levels of organotin were found to be approximately 160 times higher in the sample obtained from the box of the "contaminated" joint compound when compared to the sample collected from the box of the "normal" joint compound [1800 microgram/gram (ug/g) versus 11 ug/g respectively]. Levels of organotin found in the samples of the dried joint compound taken from the walls of the residence were somewhat lower with 780 and 770 ug/g found in the two samples collected. Analysis of these samples for total tin indicated the presence of 2100 ug/g in the sample obtained from the "contaminated" box, and 860 ug/g in a sample of the dried compound from a bathroom wall. The remaining two samples were found to be below the limit of detection of 300 ug/g. It should be noted that due to the nature of the bulk material samples, substantial interferences were encountered during the total tin analysis, and therefore, the sample results for organotin should be considered more reliable.

### B. Medical

During the medical site visit, three of the four exposed workers who had been seen by a local occupational health physician were interviewed (the fourth worker was out of town during the visit). Based on the information obtained through these interviews, the following is a course of events that occurred during and after the exposure.

During the week of September 15, 1986, four drywall finishers (all employees of Design Drywall Specialties Inc.) worked with a batch of drywall joint compound which was later determined to contain higher than usual amounts of a preservative agent. Two of the workers began using the "contaminated" compound on Monday, September 15, 1986. One of these workers was interviewed and reported that the compound had an unusual odor. This worker reported that after 4 hours of using the compound, he noted the onset of a severe headache, nausea, cough, and eye and throat irritation, but he reported that the other worker remained asymptomatic. The two workers continued work on Tuesday, with the interviewed worker experiencing a headache as well as, eye and throat irritation and the second worker remaining asymptomatic. On Wednesday morning, the previously asymptomatic worker reportedly began to feel strangely and had difficulty using his hands. Both workers then decided to stop work because of concern that the drywall joint compound might be affecting them. The two employees returned to work on Thursday, but decided to stop work because they were both experiencing headaches and had developed blistering of the skin on their faces.

On Tuesday September 16, 1986, another worker, who had obtained drywall joint compound from the house where the two workers mentioned above were working, started applying the compound in another house using a spray gun. The worker noted a strong chemical odor emanating from the compound, but continued to work with the compound. After 3 hours the worker was unable to continue work because of nausea and severe eye, throat, and respiratory irritation.

The fourth affected worker used a batch of the contaminated drywall joint compound on Friday September 19th. He was unaware of the symptoms experienced by the three other workers who had used the contaminated compound earlier in the week. Upon beginning work with the compound, he noted an unusual solvent-like smell coming from the compound but continued using it. After 2 hours of compound use, he was experiencing hand tremor, dizziness, and slight nausea. At that time, a Design Drywall Specialties Company supervisor, who was aware of the illness experienced by the other workers earlier in the week, came to the work site. Upon learning that the worker was ill, the supervisor advised him to stop work. The worker did not work on Saturday, but he began to have severe headaches on that day and he also noted the appearance of a mild rash on his hands. He worked the following Monday through Thursday, but stopped work after that time because he was plagued with unrelenting severe headaches.

Regarding the conditions of exposure, the interviewed workers reported that they had worked in new houses with little outside ventilation. (Windows were either closed or only slightly open due to the cool fall weather.) They also reported that there was much skin contact (hands, arms, face) with the compound during mixing and use.

The skin lesions reported by two of the workers cleared relatively quickly, but frequent severe headaches have continued in the three interviewed workers. All three employees have been unable to return to work because of marked fatigue (lack of energy, frequent naps in afternoon, etc.) and the recurring headaches. (Reportedly the fourth worker has also been unable to return to work.) The three interviewed workers report that periods of mental concentration, stress, or prolonged driving, will usually be accompanied by onset of headaches (either bitemporal or occipital). All three have also noted frequent severe irritability which was not present prior to the use of the contaminated drywall joint compound. Two reported being noticeably forgetful. (They now must write down appointments, errands, etc.) One has had difficulty in concentrating, especially while reading (will "drift" away from story). One has had sleep difficulties due to frequent nightmares and one has been awakened from sleep frequently because of headaches. In general there has been some improvement in their symptoms over the last few months, but progress has been slow. The affected workers have undergone a comprehensive medical evaluation that has documented the presence and progression of symptoms, but to date has not detected any abnormal physical signs or significant abnormal laboratory results.

## VII. DISCUSSION AND CONCLUSIONS

The environmental testing did not detect any residual airborne organic tin exposure in one of the houses in which the "contaminated" drywall joint compound had been applied, but the testing of a sample of drywall joint compound removed from this house showed a relatively high level of organic tin. Likewise, the analysis of "a contaminated" batch and an "uncontaminated" batch of drywall joint compound showed a level of organic tin 180 times higher in the contaminated batch. These results combined with the onset of similar symptoms in workers who were exposed to the "contaminated" batch of drywall joint compound at three different worksites, strongly suggests that one or more constituents of the "contaminated" batch were related to the appearance of symptoms in the affected workers.

It is of interest that the most prominent central nervous system symptoms reported by the drywall finishers were also prominent symptoms experienced by a group of Ohio industrial workers who were inadvertently exposed in 1978 to another trialkyl organotin compound, tri-methyltin chloride. After that exposure, 12 "highly exposed" workers experienced a significantly higher incidence of headache, fatigue, lack of initiative, forgetfulness, sleep disturbance, and irritability, than did 10 of their "lower exposed" occupational colleagues.[5] However, while the organotin compounds, trimethyl tin and triethyl tin, have been extensively studied and documented to have neurotoxic effects in both animals and man, only limited research regarding the neurotoxic effects of TBTO has been conducted. Several reports have found no neurotoxic effects in certain rodent species,[2,13] while another study reported depletion of certain neurotransmitter chemicals in the brains of rats.[6] No reports of neurologic effects of TBTO in man could be located, but reports concerning any human health effects for TBTO are too sparse to draw firm conclusions regarding its neurotoxic potential in man. Considering the lack of adequate negative toxicological data, the possibility that the workers present chronic central nervous system symptoms are due to TBTO exposure must be strongly considered. There is, of course, a chance that the present chronic central nervous system symptoms are due to a post traumatic stress reaction to the acute affects of their exposure incurred in mid-september. It is also possible that the workers were affected by combined exposure to two or more of the four compounds that the "contaminated" drywall joint compound reportedly contained in excess.

## VIII. RECOMMENDATIONS

1) Since the etiology of the workers symptoms is still unclear, it would be advisable to document as well as possible the constituents of any unused boxes of the contaminated batch of drywall joint compound. Such an analysis would evaluate the possibility that the company that formulated the drywall joint compound was supplied with a preservative material that contained compounds other than or in addition to the four normal ingredients of the preservative material (bis(tri-n-butyltin) oxide, methyl alcohol, hexylene glycol, and 2-[(hydroxymethyl)amino] ethanol). It would be most important to specifically analyze for all organotin compounds, to assure that another tri-alkyltin compound (eg. tri-ethyl or tri-methyl tin) was not inadvertently added to the drywall joint compound instead of or in addition to TBTO. Following verification of the constituents of the drywall joint compound, it would be helpful to do a head space analysis on a batch of the "contaminated" compound to provide additional information which might possibly help to estimate the potential employee exposures.

2) Available product distribution records should be reviewed to attempt to determine if joint compound from the same batch or lot number may have been used at other job sites. If so, attempts to obtain information from the employees working at these job sites regarding any health problems which they may have experienced might result in the production of additional meaningful data. Joint compound from the same batch or lot still remaining in the marketplace should be recalled, or the purchasers should be adequately warned of the potential hazards which may be associated with its use.

3) Manufacturers of the joint compound should adopt stricter control procedures during product formulation to ensure that concentrations of any potentially toxic components are maintained within safe levels.

## IX. REFERENCES


1. American Conference of Governmental Industrial Hygienists, Documentation of Threshold Limit Values, Fourth Ed. Cincinnati, Ohio, American Conference of Governmental Industrial Hygienists, 1980.

2. National Institute for Occupational Safety and Health. Criteria for a Recommended Standard--Occupational Exposure to Organotin Compounds. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1976. [DHEW publication no. (NIOSH) 77-115].

3. Goh, CL (1985): Irritant dermatitis from tri-N-butyl time oxide in paint. Contact Dermatitis 12(3):161-163.

4. Derobert L (1960): poisoning by an organic tin compound (di-iodoethyl tin or Stalinon). J. Forensic Med. 7:192.

5. Ross WD, Emmett EA, Steiner J, Tureen R (1981): Neurotoxic effects of occupational exposure to organotins. Am J. Psychiatry 138(8):1092-1095.

6. Robinson, I.M., "Effects of Some Organotin Compounds on Tissue Amine Levels in Rats", Food and Cosmetic Toxicology, Vol. 7, Pergamon Press, Great Britian, 1969.

7. Barnes JM, Stoner HB (1959): The toxicology of tin compounds. Pharmacol. Rev. 11:211-231.

8. Newman JW, Schoenborn TF, Tatken RL. Chemicals/process classified as carcinogens. Cincinnati, Ohio: The National Institute for Occupational Safety and Health, Technical Information Branch, Division of Standards Development and Technology Transfer. April, 1985.

9. National Institute for Occupational Safety and Health. NIOSH Pocket Guide to Chemical Hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. [DHEW publication no. (NIOSH) 78-210].

10. American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1986-1987. Cincinnati, Ohio, American Conference of Governmental Industrial Hygienists, 1986.

11. National Institute for Occupational Safety and Health. Occupational Health Guidelines for Chemical Hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. [DHEW publication no. (NIOSH) 81-123].

12. Tanaka, S., Lucas, JB, "Dermatitis in Paperhangers", Contact Dermatitis, Vol. 10, No. 1, January 1984.

13. Krigman MR, Silverman AP: General toxicology of Tin and Its Organic Compounds. Neurotoxicology 5 (2): 129-140, 1984.

## X. AUTHORSHIP AND ACKNOWLEDGMENTS


Report Prepared By:

William J. Daniels, CIH, CSP
Industrial Hygienist
NIOSH - Region VIII
Denver, Colorado

Bobby Gunter, Ph.D., CIH.
Regional Consultant
NIOSH - Region VIII
Denver, Colorado

Thomas G. Wilcox, M.D.
Medical Officer
Division of Surveillance, Hazard
Evaluations & Field Studies
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Division of Surveillance, Hazard
Evaluations & Field Studies
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Laboratory Support
Utah Biomedical Test Laboratory
Salt Lake City, Utah


## XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH publications office at the Cincinnati, address. Copies of this report have been sent to the following:

A. Design Drywall Specialties, Inc.
B. Gold Bond Building Products
C. Tri-County Health Department, Colorado
D. U. S. Department of Labor, OSHA - Region VIII
E. NIOSH Regional Offices/Divisions

TABLE 1

RESULTS OF AREA AIR SAMPLES ANALYZED FOR ORGANOTIN
Collected 10/15/86
5838 S. Olathe Way, Arapahoe County, Colorado

| Sample Location/ Room | Type of Collection Media | Sample Time (Minutes) | Sample Volume (Liters) | TWA Concentration Organotin |
|---|---|---|---|---|
| Entrance hall | Filter | 301 | 551 | < LOD |
| Southeast bedroom | Filter | 300 | 549 | ** |
| Master bedroom | Filter | 299 | 547 | < LOD |
| Master bathroom | Filter | 298 | 545 | < LOD |
| Living room | Filter | 290 | 244 | < LOD |
| | Charcoal Tube | 290 | 244 | < LOD |
| South bedroom | Filter | 289 | 352 | < LOD |
| | Charcoal Tube | 289 | 352 | < LOD |

KEY
< LOD - Less than the limit of detection of 0.2 micrograms tin/ sample
** - Not analyzed due to sample loss during analysis.

TABLE 2

RESULTS OF BULK SAMPLES ANALYZED FOR TIN AND ORGANOTIN
Collected 10/15/86
5838 S. Olathe Way, Arapahoe County, Colorado

| Description of Bulk Sample | Micrograms Tin/ Gram Sample | Micrograms Organotin/ Gram Sample |
|---|---|---|
| Joint compound from box identified as "normal" - Lot #090286 22R22 | < LOD | 11 |
| Joint compound from box identified as "contaminated" - Lot #082186 22F09 | 2100 | 1800 |
| Dried joint compound from master bathroom | < LOD | 780 |
| Dried joint compound from southeast bedroom. | 860 | 770 |

< LOD - Less than the limit of detection; 300 micrograms per gram for tin, and 3 micrograms per gram for organotin.