Pasadena

RISKFOCUS

January 8, 1991

Mr. Stephen B. Kemp
Industrial Hygiene Manager
Corporate Medical
Occidental Chemical Corporation
Occidental Chemical Center
360 Rainbow Boulevard South
Box 728
Niagara Falls, NY 14302

Dear Steve:

We are pleased to submit the attached draft report of the employee exposure monitoring and area noise measurements accomplished at the Pasadena, Texas, PVC Resins and Compounds Plant during the week of December 10, 1990. We trust that this monitoring effort meets the OSHA requirements to award this plant the STAR Status under the OSHA VPP. Please review the report at your earliest convenience and provide your comments to me. We will integrate your comments and remove the "Draft" header for submission to OSHA through you.

If you have any questions or comments, please do not hesitate to call me at 1-800-283-7727 (ext 6721).

Thank you for this opportunity to provide our Industrial Hygiene services. We look forward to continuing our support of OxyChem Corporate Medical in addressing health issues in the work place and community.

Sincerely,

Edward A. Guida

Edward A. Guida, PE, CIH
Manager
Occupational Health Services
RiskFocus®
Virginia Office

OCC 10927

Versar INC.
ENVIRONMENTAL RISK MANAGEMENT

OCC 10928

EMPLOYEE EXPOSURE MONITORING
OCCIDENTAL CHEMICAL CORPORATION
PVC RESINS AND COMPOUNDS PLANT
PASADENA, TEXAS

Prepared for
Mr. Stephen B. Kemp
IH Manager, Corporate Medical
OxyChem
360 Rainbow Boulevard South, Box 728
Niagara Falls, NY 14302

Prepared by

RiskFocus®
VERSAR Inc.
Springfield, Virginia

January 1991

Foreword

This report was prepared under the management and supervision of the **RiskFocus** Division of VERSAR Inc., located in the Washington, D.C. metropolitan area. **RiskFocus** provides comprehensive *stewardship* for product integrity and registration, worker safety, waste disposal, regulatory interpretation and compliance, and risk communication.

Authorship of this report is credited to Edward A. Guida, PE, CIH. Quality assurance is credited to Scott R. Baker. Further information about this report may be obtained by writing directly to the Director, **RiskFocus** Division or by calling (703) 642-6884.

Robert G. Tardiff, Ph.D., ATS
Director, **RiskFocus®**
Virginia Office

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Employee Exposure Monitoring
Occidental Chemical Corporation
PVC Resins and Compounds Plant
Pasadena, Texas

I. *Introduction*

At the request of Mr. Stephen B. Kemp, OxyChem Corporate Medical Industrial Hygiene Manager, **RiskFocus** was retained to lead an Industrial Hygienist (IH) Team in the accomplishment of employee exposure monitoring at the OxyChem Pasadena, Texas, PVC Resins and Compounds Plant. The Pasadena Plant manager had applied, in February 1989, for OSHA STAR Status under the OSHA Voluntary Protection Programs (VPP). In essence, the STAR Status from OSHA is recognition that organizational safety and health programs exceed OSHA requirements and that employees as well as managers strive for safe and healthful work environments. Facilities granted STAR Status are removed from the OSHA inspection list, but audits of injuries/illnesses and accident investigations may be accomplished according to OSHA VPP procedures. OSHA, as a result of their audit of the safety and health programs, granted a provisional STAR Status to the Pasadena PVC Plant contingent that certain employee exposure monitoring be accomplished within a 90 day period following the OSHA audit which ended on

November 9, 1990. The need to measure employee exposures to PVC dusts, welding fumes, and noise was specifically identified by the OSHA auditors during the OSHA closing conference. According to one OxyChem senior Industrial Hygienist, as a result of a teleconference with one of the OSHA auditors, solvents should also be sampled.

This report describes the risk assessment accomplished by the IH Team. Section III, Findings and Discussion, contains the results of the noise measurements and exposure monitoring in light of the risk assessment criteria. Where overexposures are found, the adequacy of existing exposure controls are discussed. In Section IV, conclusions regarding the employees' exposures are discussed and recommendations to control their exposures are provided, where needed. The air sampling, noise dosimetry, and area noise measurement data sheets are included in the Appendix.

II. Background

A. Scope of Services

The objective of this task assignment was to accomplish exposure monitoring as specified by the OSHA auditors to assure the OxyChem officials that the STAR Status would be awarded. As a result of this task assignment, a two day plant pre-survey, developing a monitoring plan, and a one week monitoring survey were accomplished. Mr. Edward A. Guida, PE, CIH, Manager of Occupational Health Services, **RiskFocus**, leads the IH Team for the monitoring survey, the exposure monitoring management, and reporting.

1. Two-Day Plant Pre-Survey

Mr. Guida visited the Pasadena PVC Plant on November 29 and 30, 1990, to become familiar with plant operations and processes as well as collect data needed to develop the monitoring plan. The monitoring plan included noise dosimetry, PVC dust sampling, and welding fume sampling as specified by the OSHA auditors. Sampling for organic chemicals in the laboratories and in the solution preparation area were also included in the plan. Exposures to vinyl chloride monomer (VCM) during filter changes at the Liquid Loading Rack had not previously been measured; sampling for VCM during filter change was identified. Area noise surveys were performed to supplement noise dosimetry measurements.

2. Monitoring Plan

The monitoring plan developed for the Pasadena PVC Plant included area noise surveys, noise dosimetry, and a personal air sampling strategy to measure employee exposures to chemical substances. Tables 1, 2, and 3 summarize each aspect of the planned environmental testing for this plant.

Table 1

AREA NOISE SURVEYS	
Area	**Noise Source**
Waste Treatment Plant	Compressor
F-8 Boiler Plant	Boilers
Steam Plant	Boilers
AFE Shop	Shop Equipment
Machine Shop	Shop Equipment including Sandblast Cabinet and Press. Washer
PVC Maintenance Shop	Port. Welder & Compressor
PVC Bagging	Bagging Machine
PVC Refrigeration Compressors	Refrigeration Equipment
#1 and #3 Dryer	Blowers
PVC Loading (Rail Car)	#1 and #3 Dryer Blowers
Car Cleaners	Equipment
Recovery Area	Equipment

Table 2

NOISE DOSIMETRY	
Area	**Number of Employees Per Shift**
F-8 Boiler	≤ 5
Steam Plant	
AFE Shop	~ 5 (welders/boiler-makers)
Machine Shop	6 (plant wide exposures)
Liquid Loading Rack	2 (1 OxyChem, 1 Contract)
PVC Bagging	1
Reactor Building	3 (two 12-hr shifts)
Dryer Buildings (6)	2 (two 12-hr shifts)
PVC Loading (Rail Car)	2 (two 12-hr shifts)
Car Cleaners	4
Recovery Area	1

Table 3

AIR SAMPLING STRATEGY		
Area	**Substance**	**No. of Employees Per Shift**
AFE Shop	Welding Fumes (NOC) Zinc Oxide Sand (Silica) (Respirable) Sand (Silica) (Total)	6 6 6 6
QC & Env. Lab	Freon 113 Carbon Disulfide	2 1
Machine Shop	Welding Fumes (NOC)	6
Liquid Loading Rack	Vinyl Chloride (during filter change)	1
PVC Maintenance Shop	Welding Fumes (NOC)	1 (two 12-hr shifts)
PVC Bagging	PVC Dust (PNOC) (Respirable) PVC Dust (PNOC) (Total)	1 1
QC Lab (PVC Plant)	Cyclohexanone Acetone Dioctylphthalate Isopropanol	2 (two 12-hr shifts) 2 (two 12-hr shifts) 2 (two 12-hr shifts) 2 (two 12-hr shifts)
Solution Prep	Isobutanol Methyl Cellulose Polyvinyl Alcohol	3 (two 12-hr shifts) 3 (two 12-hr shifts) 3 (two 12-hr shifts)
Dryer Buildings (6)	PVC Dust (PNOC) (Respirable) PVC Dust (PNOC) (Total)	2 (two 12-hr shifts plus maintenance employees) 2 (two 12-hr shifts plus maintenance employees)
PVC Loading (Rail Car)	PVC Dust (PNOC) (Respirable) PVC Dust (PNOC) (Total)	2 (two 12-hr shifts) 2 (two 12-hr shifts)
Car Cleaners	PVC Dust (PNOC) (Respirable) PVC Dust (PNOC) (Total)	4 4

The Area Noise Surveys table (Table 1) shows the areas of the plant where sources of potentially hazardous noise emissions could occur. The noise emissions were measured with a sound level meter set to the A weighting network on slow response. The noise measurements would provided data that could be useful in noise abatement efforts. Noise dosimetry is identified on an area/job basis to measure employee noise exposures during their job activities. The air sampling is also identified on an area/job basis to measure employee exposures to airborne contaminants as a result of activities in the work area or according to a job.

3. Monitoring Survey

The IH Team accomplished the noise measurements, noise dosimetry, and air sampling during the week of December 10-14, 1990. The sampling was prioritized to ensure that PVC dusts, welding fumes, and noise dosimetry were collected during the monitoring survey. Area noise surveys and air sampling for organic chemicals were given a secondary priority. All planned environmental testing and monitoring was accomplished.

The monitoring plan accounted for the fact that the production of PVC products at the Pasadena Plant requires around-the-clock workshifts. Where shift work was identified, monitoring during evening and night shifts was scheduled to address the temporal affects of employee exposures during different shifts. Employees have been assigned to work groups and scheduled to different shifts according to a published schedule. Accomplishing exposure monitoring during all shifts provided data to estimate all employee exposures as they rotated work shifts.

The following personnel comprised the IH Team:

Edward Guida, PE, CIH	**RiskFocus**
John Davis, CIH	Occusafe
Robert McKinley, CIH	Occusafe

Tom Olendorf	OxyChem

The following OxyChem Pasadena Plant personnel were contacted for this monitoring survey and provided plant escort for the exposure monitoring:

Jim Oliver	Manager, Safety, Security & Loss Control
William Seale	Safety
Ray Hudson	Safety

A brief closing conference to discuss the monitoring survey was conducted on December 14, 1990. The following OxyChem personnel were in attendance.

Pasadena PVC Plant Officials:

Jim Oliver	Manager, Safety, Security & Loss Control
Charles Brown	Human Resources
Gary Jones	Production Manager and Acting Plant Manager
Scott Harp	PVC Production Superintendent
David Payne	PVC Production Engineer
Bill Miller	Maintenance Superintendent
Larry Burman	Technical Services Manager
Bill Seale	Safety
Ray Hudson	Safety
Martha Ackel	QC and Environmental Laboratory

OxyChem Corporate Medical representatives:

Steve Kemp	IH Manager
Tom Olendorf	Associate IH

The monitoring activity was described. Air sample results were not available and noise dosimetry results had not yet been evaluated. The area noise survey results were discussed briefly; the discussion focused on abatement efforts at the Dryer blowers.

B. Risk Assessment Criteria

The criteria used for this risk assessment included the OSHA Permissible Exposure Limits (PELs) and the ACGIH Threshold Limit Values (TLVs). Where work shifts exceed eight hours, arithmetic adjustments in these exposure limits were made to ensure that adequate health conservation measures would be taken if they were not already in place. Table 4 shows the eight-hour time-weighted hour (TWA_8) TLVs and PELs and short-term exposure limits (STELs) for noise and the chemicals monitored during this survey. Blank cells in the table indicate that OSHA and/or ACGIA has not established a TLV or PEL for that substance.

It must be realized that the definition of an STEL is different for ACGIH and OSHA. The ACGIH STEL definition allows four 15-minute exposures per work day with at least one hour between exposures. The OSHA definition allows one 15-minute exposure per work day.

PNOCs are defined as "particulates not otherwise classified." For particulate air contaminants for which there is no PEL or TLV, the PNOC exposure limit is applied. A cyclone attachment to the air sampling filter cassette is used to separate the particulates so that the dust fraction with mean aerodynamic diameters less than 10 microns can be collected. These particles are defined as respirable. Total PNOCs (particles of all sizes) are collected on a filter cassette without the cyclone. For this project, PVC dusts were collected as PNOCs (respirable and total) and exposure levels were assessed using the PNOC exposure limits.

While the ACGIH TLVs are listed here as occupational exposure limits, TLVs are recommendations to be used by professional industrial hygienists in the evaluation of occupational settings. TLVs are not regulatory; the OSHA PELs are regulatory and enforceable as federal laws. The TLVs are used to supplement the OSHA PELs in the evaluation of employee exposures at the Pasadena PVC Plant in the context of "wellness" in the work place.

Among the metals listed in Table 4, the last 13 chemicals (from beryllium to zinc) constitutes a welding fume screen (testing standard) for each welding fume air sample analyzed by the IH laboratory. It is not the intent of this air sampling strategy to test for these metals individually unless there is a compelling reason, as is the case for zinc oxide. Zinc oxide fumes are generated during welding of galvanized components.

Table 4

OCCUPATIONAL EXPOSURE LIMITS[1]				
Substance	TLV-TWA$_8$ (mg/m^3)	TLV-STEL (mg/m^3)	PEL-TWA$_8$ (mg/m^3)	PEL-STEL (mg/m^3)
Noise	85 dBA		90 DBA	
PNOC (Total)	10		15	
PNOC (Respirable)			5	
Carbon Disulfide	31 (skin)		12 (skin)	36 (skin)
Isobutanol	152		150	
Acetone	1780	2380	1800	2400
Isopropanol	983	1230	980	1225
Cyclohexanone	100 (skin)		100 (skin)	
Dioctylphthalate	5			
Zinc Oxide (fume)	5	10	5	10
Beryllium	0.002 (A2)		0.002	0.025 (peak)
Cadmium	0.05 (C)		0.1	0.3 (C)
Cobalt	0.05		0.05	
Chromium	0.5		0.5	
Copper	0.2		0.1	
Iron	5		10	
Manganese	1	3	1	3
Molybdenum	5		5	
Nickel	1		1	
Lead	0.15		0.05	
Antimony	0.5		0.5	
Vanadium	0.05		0.05	
Zinc	5	10	5	10

[1] American Conference of Governmental Industrial Hygienists. 1990. *Guide to Occupational Exposure Values—1990*; ACGIH, Cincinnati, OH

[2] Sax, Irving N. 1984. *Dangerous Properties of Industrial Materials*, 6th Edition; Van Nostrand Reinhold Company, New York; page 1224.

III. Findings and Discussion

The results of the exposure monitoring for noise and air contaminants are discussed in this section in light of the applicable occupational exposure limits (OELs). Area noise measurements are discussed as they pertain to employee exposure, hazardous noise area designation, and hazardous noise abatement.

A. Noise Dosimetry

Noise dosimetry was performed on employees throughout the plant during the week of December 10, 1990; day and night-shift exposures were measured. Metrosonics model 3100 noise dosimeters were used to measure exposures during full working shifts.

The Metrosonics dosimeter with the Metrosonics computer software is capable of extensive evaluation of the collected noise data. For the purpose of this survey, only the time weighted average (TWA) exposure data are used to evaluate the employee noise exposures (see Table 5). The TWA exposure measurement includes

Table 5

EMPLOYEE NOISE EXPOSURES

Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift/Length	Work Area	Job Title	Sampling Time	TWA
91560	12/11/90	D/8	AFE SHOP	FINISHER	7.55	87
91555	12/10/90	N/12	DRYER AREA	OPERATOR TECHNICIAN	11.02	93
91556	12/10/90	N/12	DRYER AREA	OPERATOR TECHNICIAN	12.01	88
91574	12/13/90	D/8	F-8 BOILER AREA	BOILER OPERATOR	7.30	81
91559	12/10/90	N/8	LIQUID LOADING	OPERATOR TECHNICIAN	8.30	77
91569	12/13/90	D/8	LIQUID LOADING	LIQUID LOADER	7.02	92
91562	12/11/90	D/8	MAINTENANCE MAIN SHOP	MAINTENANCE TECHNICIAN	6.24	79
91561	12/11/90	D/8	OFFSITES	STEAM PLANT OPERATOR	5.21	83
91557	12/10/90	N/12	PVC LOADING	OPERATOR TECHNICIAN	8.52	88
91558	12/10/90	N/12	PVC LOADING	OPERATOR TECHNICIAN	11.19	97
91563	12/11/90	D/12	PVC LOADING	PVC LOADER	6.49	87
91564	12/11/90	D/8	PVC LOADING	PVC BAGGER	6.51	89
91571	12/13/90	D/12	PVC LOADING	PVC BAGGER	9.58	91
91572	12/13/90	D/12	PVC LOADING	CAR CLEANER	7.00	91
91565	12/11/90	D/12	PVC PRODUCTION	DRYER OPERATOR	9.28	96
91566	12/11/90	D/12	PVC PRODUCTION	BOTTOM REACTOR OPERATOR	9.27	87
91567	12/11/90	D/12	PVC PRODUCTION	RECOVERY OPERATOR	9.24	86
91573	12/13/90	D/8	PVC PRODUCTION	CAR CLEANER	7.52	89
91552	12/10/90	N/12	REACTOR BOTTOM	OPERATOR TECHNICIAN	7.52	85
91553	12/10/90	N/12	REACTOR DECK	OPERATOR TECHNICIAN	10.49	86
91554	12/10/90	N/12	REACTOR DECK	OPERATOR TECHNICIAN	10.57	85
91551	12/10/90	N/12	RECOVERY	OPERATOR TECHNICIAN	10.34	88

all noise exposures integrated in the dosimeter above 80 dBA. This 80 dBA cut-off is consistent with the OSHA Occupational Noise Standard, 29 CFR 1910.95, Appendix A, which shows reference allowable exposure durations for TWA noise exposures as low as 80 dBA.

Two noise criteria were used to evaluate the risk to high-intensity noise exposure: one for eight-hour work shifts and one for 12-hour work shifts. The TLV- and PEL-TWA_8 shown in the Risk Assessment Criteria section (Section B) of the Introduction applies to the eight-hour work shifts. For 12-hour work shifts, the criteria must be reduced to compensate for the longer exposure time. The noise PEL-TWA_{12} is 87 dBA; the noise TLV-TWA_{12} is 82 dBA.

Throughout this plant, high noise levels were encountered. However, a comprehensive hearing conservation program was evident. Hazardous noise areas were posted and hearing protection was worn by exposed personnel — employees and visitors. Many forms of hearing protection were available including several kinds of ear plugs, semi-insert hearing protectors, and ear muffs. The employees carry hearing protection as a part of their safety equipment ensemble and the IH Team members observed consistent use of hearing protection in the designated hazardous noise areas. This practice ensures that high noise exposures were controlled to prevent hearing loss.

The available hearing protection was adequate to protect employees from the adverse effects of the high intensity noise. The lowest noise reduction rating (NRR) noted on a hearing protection device equalled 22 dBA (with the semi-insert hearing protector). Using the OSHA method to estimate protection, which involved subtracting 7 dB from the NRR before subtracting the NRR from the measured noise exposure, the NRR equalled 15 dB. The highest TWA noise exposure measured was 96 dBA on a Dryer operator. Reducing this exposure by 15 dB results in an exposure of 81 dBA, 6 dB below the PEL-TWA_{12} and 1 dB below the TLV-TWA_{12}. Use of ear plugs and/or ear muffs would improve the protection further.

In the Dryer area of the plant, noise levels were noticeably higher and of a unique quality. At Dryers numbers 1 and 3, there are blowers that emit a pure tone of 600 Hertz (Hz) at about 108 dBA. The employees working in the Dryer area and the Rail Car loading area, which includes Rail Car loaders and Rail Car cleaners, are affected by this noise emission. TWA exposures in excess of the OSHA PEL in these areas were caused by these high-level noise emissions. Hearing protection was worn by all personnel in these areas.

Efforts to control the noise emissions from the Dryer blowers is ongoing. Past efforts with passive devices have not been effective because of maintenance problems and clogging with PVC resin. Engineers are continuing to investigate alternate methods to reduce the noise emissions, including replacement of the blowers. Active noise control devices should be investigated. Active noise control devices may be most effective in the low frequency range. They work on the principle of noise cancellation by adding a high intensity noise to the process out of phase with the noise emission to cancel the process noise.

The noise exposures at the Liquid Loading area were expected to be low. Measurement on one individual involving night-shift dosimetry was 77 dBA, which validated this expectation. However, the day-shift measurement on a different employee was 92 dBA; this level was not anticipated. This day-shift employee was involved in filling and switching tank car operations in the PVC Loading area including operating a "trackmobile." Noise measurements were not collected on the trackmobile; but trackmobiles at other OxyChem plants have been noted as being very loud.[1] The employee wore hearing protection during his activities in the PVC Loading area and while operating the trackmobile.

The PVC Baggers were exposed to noise that measured 89 dBA for an eight-hour shift and 91 dBA for a 12-hour work shift. One level exceeded the OSHA PEL; both exceeded the TLVs. It was noticed that a compressed air device on the bagging machine emitted a high intensity noise. The Bagger has been designated a hazardous noise area and the Bagger wore hearing protection.

B. Air Sampling

1. PVC Loading

Seven day-shift and eight night-shift personal air samples for PVC dusts (identified as PNOCs) were collected on Rail Car loaders. Four of the day-shift and four of the night-shift samples were collected using cyclones to separate the respirable fraction.

These employees load PVC resin material into Rail Cars from overhead silos. The loader controls the resin flow through a flexible duct from the silo to the Rail Car port. The loader also clears apparent "clumping" with a long rod.

All of the employee exposures to PVC dusts in the PVC Loading area, as demonstrated by air sampling, were well below the applicable exposure limits (see Table 6). Exposures measured during the day-shift were similar to the levels measured during the night-shift.

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[1] Teleconference between Mr. Ed Guida, **RiskFocus**, and Mr. Tom Olendorf, OxyChem, on January 7, 1991. Mr. Olendorf referred to his knowledge about the trackmobile noise environment at the plant located in Matagorda, Texas.

Table 6

TWA EXPOSURE MEASUREMENTS

PVC Loading - Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift	Job Title	Sampling Time	Material	Results (mg/m3)
91501	12/10/90	N	OPERATOR TECH.	332	PNOC-TOTAL	0.24
91503	12/10/90	N	OPERATOR TECH.	352	PNOC-TOTAL	0.64
91508	12/10/90	N	OPERATOR TECH.	319	PNOC-TOTAL	0.63
91509	12/10/90	N	OPERATOR TECH.	333	PNOC-TOTAL	0.16
91533	12/11/90	N	OPERATOR TECH.	342	PNOC-RESP.	0.068
91534	12/11/90	N	OPERATOR TECH.	340	PNOC-RESP.	0.17
91541	12/11/90	N	OPERATOR TECH.	318	PNOC-RESP.	0.055
91542	12/11/90	N	OPERATOR TECH.	320	PNOC-RESP.	<0.017
91511	12/11/90	D	PVC LOADER	447	PNOC-TOTAL	0.15
91512	12/11/90	D	PVC LOADER	374	PNOC-TOTAL	0.74
91523	12/11/90	D	PVC LOADER	211	PNOC-TOTAL	0.20
91546	12/12/90	D	PVC LOADER	327	PNOC-RESP.	0.071
91605	12/12/90	D	PVC LOADER	404	PNOC-RESP.	0.12
91607	12/12/90	D	PVC LOADER	208	PNOC-RESP.	0.056
91608	12/12/90	D	PVC LOADER	215	PNOC-RESP.	0.17

While air sampling indicates that no employee overexposures would be expected in this work area during the loading activities, cleaning the Rail Cars with compressed air entrains high levels of PVC dust in the environment. Such high dust levels can irritate or injure the eyes, obscure vision, and excessive dust on walking surfaces can cause slipping and falls. A vacuum system is used to clean interiors of Rail Cars. Use of such a system to clean spillage would eliminate PVC dust entrainment in the air and collect the resin for resale.[2]

2. PVC Production

The results of the air sampling conducted in the PVC Production areas, Car Cleaning, Dryer operations, QC Laboratory operations, and the Bagging operation are shown on Table 7.

a. *Rail Car Cleaners.* Eight day-shift air samples for PVC dusts were collected on the Rail Car cleaners during cleaning operations. Four of these air samples were for the respirable dust fraction. All exposures were well below the applicable exposure limits. No overexposure conditions are expected during Rail Car cleaning activities.

b. *Dryer Operators.* Eight day-shift and eight night-shift air samples for PVC dusts were collected on the Dryer operators. Half of these air samples were for the respirable dust fraction. All of the night-shift exposure levels and all of the day-shift respirable dust exposure levels were well below the applicable exposure limits. Three of the day-shift total dust levels were significant: one exceeded the PEL-TWA_8, two exceeded the TLV-TWA_8, and one exceeded one-half of the TLV-TWA_8.

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[2] Correspondence from Mr. John Davis, CIH, Occusafe, to Mr. Ed Guida, **RiskFocus**, dated December 28, 1990.

Table 7

TWA EXPOSURE MEASUREMENTS

PVC Production - Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift	Job Title	Sampling Time	Material	Results (mg/m3)
91530	12/13/90	D	CAR CLEANER	259	PNOC-TOTAL DUST	0.068
91531	12/13/90	D	CAR CLEANER	265	PNOC-TOTAL DUST	0.12
91545	12/12/90	D	CAR CLEANER	327	PNOC-RESP. DUST	0.35
91606	12/12/90	D	CAR CLEANER	325	PNOC-RESP. DUST	0.036
91609	12/12/90	D	CAR CLEANER	170	PNOC-RESP. DUST	0.035
91610	12/12/90	D	CAR CLEANER	151	PNOC-RESP. DUST	<0.039
91629	12/13/90	D	CAR CLEANER	230	PNOC-TOTAL DUST	0.11
91630	12/13/90	D	CAR CLEANER	225	PNOC-TOTAL DUST	0.17
91502	12/10/90	N	DRYER OPERATOR	184	PNOC-TOTAL DUST	1.2
91504	12/10/90	N	DRYER OPERATOR	352	PNOC-TOTAL DUST	2.4
91506	12/10/90	N	DRYER OPERATOR	318	PNOC-TOTAL DUST	0.97
91507	12/11/90	N	DRYER OPERATOR	394	PNOC-RESP. DUST	0.13
91510	12/10/90	N	DRYER OPERATOR	479	PNOC-TOTAL DUST	0.30
91514	12/11/90	D	DRYER OPERATOR	412	PNOC-TOTAL DUST	16.0
91515	12/11/90	D	DRYER OPERATOR	402	PNOC-TOTAL DUST	5.6
91516	12/11/90	N	DRYER OPERATOR	345	PNOC-RESP. DUST	0.30
91526	12/11/90	D	DRYER OPERATOR	237	PNOC-TOTAL DUST	0.25
91527	12/11/90	D	DRYER OPERATOR	224	PNOC-TOTAL DUST	11.0
91537	12/11/90	N	DRYER OPERATOR	314	PNOC-RESP. DUST	0.24
91540	12/11/90	N	DRYER OPERATOR	483	PNOC-RESP. DUST	0.93
91547	12/12/90	D	DRYER OPERATOR	373	PNOC-RESP. DUST	0.062
91548	12/12/90	D	DRYER OPERATOR	395	PNOC-RESP. DUST	0.69
91611	12/12/90	D	DRYER OPERATOR	233	PNOC-RESP. DUST	0.35
91612	12/12/90	D	DRYER OPERATOR	201	PNOC-RESP. DUST	0.26
91529	12/11/90	N	LAB TECHNICIAN		ACETONE	<2.4
91529	12/11/90	N	LAB TECHNICIAN		ISOPROPANOL	<2.5
91536	12/11/90	N	LAB TECHNICIAN	228	CYCLOHEXANONE	<0.24
91538	12/11/90	N	LAB TECHNICIAN	422	ACETONE	2.88
91538	12/11/90	N	LAB TECHNICIAN	422	ISOPROPANOL	<2.5
91539	12/11/90	N	LAB TECHNICIAN	432	CYCLOHEXANONE	<0.08
91616	12/13/90	D	LAB TECHNICIAN	209	ACETONE	<2.4
91620	12/13/90	D	LAB TECHNICIAN	178	DIOCTYL PHTHALATE	<0.005
91626	12/13/90	D	LAB TECHNICIAN	344	CYCLOHEXANONE	0.68
91626	12/13/90	D	LAB TECHNICIAN	344	CYCLOHEXANONE	0.68
91628	12/13/90	D	LAB TECHNICIAN	237	DIOCTYL PHTHALATE	<0.004
91631	12/13/90	D	LAB TECHNICIAN	117	DIOCTYL PHTHALATE	<0.008
91513	12/11/90	D	PVC BAGGER	430	PNOC-TOTAL DUST	0.68
91525	12/11/90	D	PVC BAGGER	157	PNOC-TOTAL DUST	1.22
91615	12/13/90	D	PVC BAGGER	290	PNOC-RESP. DUST	0.26
91624	12/13/90	D	PVC BAGGER	322	PNOC-RESP. DUST	0.11
91618	12/13/90	D	SOLUTION PREP	254	VM & P NAPHTHA	<4.6
91627	12/13/90	D	SOLUTION PREP	247	VM & P NAPHTHA	<4.6

The high PVC dust levels were measured during cleaning of dryer magnets with compressed air hoses. The observed dust levels during this operation were very high; these air samples validated the observations. Although the respirable dust fractions were below the PEL, which indicates that dust depositions in the lower respiratory system were at unacceptable levels, reduction of the high total dust levels during magnet cleaning is necessary to comply with the OSHA PEL and conform to the ACGIH TLV. Personal protection worn during this cleaning operation included a single-use disposable dust respirator.

The protection provided by this respirator is questionable because it cannot be fit tested. The use of a properly fitted and NIOSH-certified dust respirator is required to provide adequate protection to the employee from dust overexposures. A permanent engineering control for excessive dust emission must be investigated.

Blowing components with compressed air for cleaning is inefficient and, as is seen here, can present dust level conditions in excess of the OSHA PEL and the ACGIH TLV. Furthermore, dusts that are blown from the components must subsequently be cleaned up. A vacuum system appears to make more sense in that it cleans component and collects PVC resin in a single step. Subsequent clean-up is not necessary. The vacuum can also be used to pick up other build-ups of fugitive resin emissions in the dryer buildings.

c. *Laboratory Technicians.* Eleven air samples for acetone, dioctylphthalate, isopropyl alcohol (isopropanol), and cyclohexanone were collected on the laboratory technicians in the Quality Control (QC) Laboratory of the PVC Production plant. All of the levels were below the sample detection limit with the exception of one acetone measurement and all of the cyclohexanone levels.

The exposure levels measured for acetone and cyclohexanone were well below the applicable exposure limits. Laboratory procedures involving these materials were performed in the laboratory hood. No further actions are necessary to control the airborne exposure route.

Cyclohexanone can be readily absorbed through the skin, as evidenced by the "Skin" notation on the PEL and the TLV. The PEL and TLV control the body burden caused by the airborne route of entry and do not address the body burden caused by skin absorption. Therefore, direct skin contact must be carefully controlled. The laboratory technicians wear protective eye wear and gloves when using cyclohexanone. These procedures adequately control exposures.

The levels of dioctylphthalate were below detection limits; however, these measurements might have been underestimates of actual airborne levels. For heated dioctylphthalate, the air sampling technique specified an air sampling train consisting of a glass fiber filter to be placed in tandem with a midget impinger filled with a 50% aqueous solution of isopropyl alcohol. This method collects any aerosols on the filter and vapors in the alcohol solution in the impinger. Only the filter is needed if the chemical is used at room temperature. When preparing to collect the air samples, monitoring technicians were told that dioctylphthalate was being used at room temperature. Therefore, the air samples were collected with the filter only. It was discovered afterward that the dioctylphthalate was heated. This sampling should be reconducted with the glass filter and the midget impinger in tandem.

d. *PVC Bagger.* Four personal air samples for PVC dusts were collected on the PVC Bagger during day-shifts. Two of the samples measured total dust levels and two measured the respirable dust fraction. All measured airborne levels were well below the applicable exposure limits. No further actions to control employee exposures were indicated as a result of this air sampling.

e. *Solution Preparation.* Two air samples for varnish makers' and printers' naphtha (VM&P naphtha) were collected on a Solution Preparation employee during operations involving the use of AK 20 Catalyst. VM&P naphtha was the only regulated substance in the catalyst formulation that could be sampled during this monitoring survey.

The measured levels of VM&P naphtha are below the sample detection limit. The monitored employee was wearing an air purifying respirator, gloves, apron, and face shield during his activities with the catalyst. These measurements indicate that the employee was adequately protected during catalyst use. However, there are other chemicals used in the Solution Preparation area. Further air sampling during the use of other materials is needed to fully characterize exposures in this area.

4. AFE Shop

a. *Welding.* Three personal air samples were collected on welders in the AFE Shop during actual welding operations (see Table 8). Operations performed during air sampling included welding of carbon steel with a few tacks on galvanized, cutting, and grinding carbon steel, and tack welding galvanized steel in a sump pit entry at the Waste Treatment plant. Protective equipment observed to be worn included welding mask and ear plugs. (Welding is conducted on carbon steels, stainless steels, galvanized carbon steels, and other metals to a lesser extent including aluminum, brass, hastaloy, and iconel.)

Except for tack welding on galvanized steel in the sump, all exposure measurements were well below the applicable exposure limits. The welder who was tack welding in the sump pit was overexposed to zinc and zinc oxide, and his exposure to iron was significant (over one-half of the TWA_8 exposure limit for iron). The orientation and proximity of the task to the welder, the awkward position that the welder must assume, and the poor ventilation in the sump pit contributed to this overexposure condition. Ventilating the pit will reduce exposure as will wear a fume air purifying respirator. However, a respirator will probably be difficult because of the location of the task.

Table 8

TWA EXPOSURE MEASUREMENTS

AFE Shop - Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift	Job Title	Sampling Time	Material	Results (mg/m3)
91518	12/11/90	D	WELDER	258	ANTIMONY	0.0005
91518	12/11/90	D	WELDER	258	BERYLLIUM	<0.0005
91518	12/11/90	D	WELDER	258	CADMIUM	<0.0005
91518	12/11/90	D	WELDER	258	CHROMIUM	<0.0005
91518	12/11/90	D	WELDER	258	COBALT	0.0005
91518	12/11/90	D	WELDER	258	COPPER	0.0009
91518	12/11/90	D	WELDER	258	IRON	0.10
91518	12/11/90	D	WELDER	258	LEAD	0.0005
91518	12/11/90	D	WELDER	258	MANGANESE	0.0019
91518	12/11/90	D	WELDER	258	MOLYBDENUM	<0.0048
91518	12/11/90	D	WELDER	258	NICKEL	<0.0005
91518	12/11/90	D	WELDER	258	VANADIUM	<0.0005
91518	12/11/90	D	WELDER	258	ZINC	0.012
91518	12/11/90	D	WELDER	258	ZINC OXIDE	0.014
91519	12/11/90	D	WELDER	204	ANTIMONY	<0.0006
91519	12/11/90	D	WELDER	204	BERYLLIUM	<0.0006
91519	12/11/90	D	WELDER	204	CADMIUM	0.0006
91519	12/11/90	D	WELDER	204	CHROMIUM	0.029
91519	12/11/90	D	WELDER	204	COBALT	<0.0006
91519	12/11/90	D	WELDER	204	COPPER	0.023
91519	12/11/90	D	WELDER	204	IRON	2.7
91519	12/11/90	D	WELDER	204	LEAD	0.0026
91519	12/11/90	D	WELDER	204	MANGANESE	0.31
91519	12/11/90	D	WELDER	204	MOLYBDENUM	<0.006
91519	12/11/90	D	WELDER	204	NICKEL	0.0078
91519	12/11/90	D	WELDER	204	VANADIUM	<0.0006
91519	12/11/90	D	WELDER	204	ZINC	14
91519	12/11/90	D	WELDER	204	ZINC OXIDE	17
91522	12/12/90	D	WELDER	424	ANTIMONY	<0.0003
91522	12/12/90	D	WELDER	424	BERYLLIUM	<0.0003
91522	12/12/90	D	WELDER	424	CADMIUM	<0.0003
91522	12/12/90	D	WELDER	424	CHROMIUM	<0.0003
91522	12/12/90	D	WELDER	424	COBALT	<0.0003
91522	12/12/90	D	WELDER	424	COPPER	0.0012
91522	12/12/90	D	WELDER	424	IRON	0.15
91522	12/12/90	D	WELDER	424	LEAD	<0.0003
91522	12/12/90	D	WELDER	424	MANGANESE	0.014
91522	12/12/90	D	WELDER	424	MOLYBDENUM	<0.0031
91522	12/12/90	D	WELDER	424	NICKEL	<0.0003
91522	12/12/90	D	WELDER	424	VANADIUM	<0.0003
91522	12/12/90	D	WELDER	424	ZINC	0.14
91522	12/12/90	D	WELDER	424	ZINC OXIDE	0.17

Careful planning of field welding is needed to ensure that overexposures are avoided. Review of the task and task environment should address the possibility of air contaminant exposure and methods to prevent overexposure. Welding should be done in the shop, as much as possible.

b. *Abrasive Blasting.* No abrasive blasting was performed during this monitoring survey; monitoring during these operations is needed to measure exposures and validate protective procedures.

5. PVC Maintenance — Welding

Three personal air samples were collected on PVC Maintenance Shop welders during actual welding operations (see Table 9). Operations performed during this sampling involved welding on stainless steel using tungsten inert gas (TIG), referred to as heliarc by the shop personnel, "stick" welding on stainless steel, and a small amount of TIG welding on galvanized steel.

Exposures to welding fumes for these employees were well below the applicable exposure limits. These measurements indicate that no further exposure controls are needed during welding operations evaluated in this shop.

6. QC and Environmental Laboratory

Two personal air samples were collected on a laboratory technician for carbon disulfide during the processing of VCM monitors. One sample was collected for 15 minutes to measure the STEL exposure (see Table 10). The other sample was collected during the remainder of the morning; afternoon work did not involve exposure to carbon disulfide. The technician wore gloves and performed the work in a laboratory hood. All exposure measurements were well below the applicable exposure limits; no further exposure controls are needed.

Table 9

TWA EXPOSURE MEASUREMENTS

PVC Maintenance - Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift	Job Title	Sampling Time	Material	Results (mg/m3)
91517	12/11/90	D	WELDER	328	ANTIMONY	<0.0004
91517	12/11/90	D	WELDER	328	BERYLLIUM	<0.0004
91517	12/11/90	D	WELDER	328	CADMIUM	<0.0004
91517	12/11/90	D	WELDER	328	CHROMIUM	0.0019
91517	12/11/90	D	WELDER	328	COBALT	<0.0004
91517	12/11/90	D	WELDER	328	COPPER	0.0011
91517	12/11/90	D	WELDER	328	IRON	0.0042
91517	12/11/90	D	WELDER	328	LEAD	0.0011
91517	12/11/90	D	WELDER	328	MANGANESE	0.0046
91517	12/11/90	D	WELDER	328	MOLYBDENUM	<0.0038
91517	12/11/90	D	WELDER	328	NICKEL	0.0004
91517	12/11/90	D	WELDER	328	VANADIUM	<0.0004
91517	12/11/90	D	WELDER	328	ZINC	0.0040
91517	12/11/90	D	WELDER	328	ZINC OXIDE	0.0049
91521	12/11/90	D	WELDER	150	ANTIMONY	<0.0008
91521	12/11/90	D	WELDER	150	BERYLLIUM	<0.0008
91521	12/11/90	D	WELDER	150	CADMIUM	<0.0008
91521	12/11/90	D	WELDER	150	CHROMIUM	<0.0008
91521	12/11/90	D	WELDER	150	COBALT	0.0008
91521	12/11/90	D	WELDER	150	COPPER	0.0008
91521	12/11/90	D	WELDER	150	IRON	<0.0008
91521	12/11/90	D	WELDER	150	LEAD	0.0041
91521	12/11/90	D	WELDER	150	MANGANESE	<0.0008
91521	12/11/90	D	WELDER	150	MOLYBDENUM	<0.008
91521	12/11/90	D	WELDER	150	NICKEL	<0.0008
91521	12/11/90	D	WELDER	150	VANADIUM	<0.0008
91521	12/11/90	D	WELDER	150	ZINC	0.0035
91521	12/11/90	D	WELDER	150	ZINC OXIDE	0.0043
91602	12/12/90	D	WELDER	444	ANTIMONY	<0.0003
91602	12/12/90	D	WELDER	444	BERYLLIUM	<0.0003
91602	12/12/90	D	WELDER	444	CADMIUM	0.0037
91602	12/12/90	D	WELDER	444	CHROMIUM	0.0006
91602	12/12/90	D	WELDER	444	COBALT	<0.0003
91602	12/12/90	D	WELDER	444	COPPER	0.0003
91602	12/12/90	D	WELDER	444	IRON	0.0071
91602	12/12/90	D	WELDER	444	LEAD	0.0003
91602	12/12/90	D	WELDER	444	MANGANESE	0.0011
91602	12/12/90	D	WELDER	444	MOLYBDENUM	<0.0028
91602	12/12/90	D	WELDER	444	NICKEL	0.0003
91602	12/12/90	D	WELDER	444	VANADIUM	<0.0003
91602	12/12/90	D	WELDER	444	ZINC	0.044
91602	12/12/90	D	WELDER	444	ZINC OXIDE	0.055

Table 10

TWA EXPOSURE MEASUREMENTS

QC and Environmental Lab (Offsite) - Pasadena PVC Plant

Sample Number	Sampling Date	Work Shift	Job Title	Sampling Time	Material	Results (mg/m3)
91617	12/13/90	D	LAB TECHNICIAN	15	CARBON DISULFI	<0.713
91619	12/13/90	D	LAB TECHNICIAN	188	CARBON DISULFI	0.806

C. Area Noise Survey

The area noise survey confirmed where hazardous noise exposures are possible and validated the posting of hazardous noise signs in specific areas of the plant. The survey data are summarized in Table 11.

Table 11

AREA SOUND LEVEL MEASUREMENTS SUMMARY			
Area	**Location**	**Noise Source**	**dBA**
Steam Plant	Control Room	Background	59-60
	Steam Plant Area	Equipment	82-96
AFE Shop	Shop Area	Equipment, ventilation fan	82-86
	Lunch Area	Roof Fan off	77
F-8 Boiler	Control Room Desk	Background	67
	Boiler Area	Equipment	83-101
PVC Maintenance Shop	Shop Area	Background, Equipment	60-82
Main Machine Shop	Office	Background	61
	Shop Area	Background	63-68
PVC Bagging Machine	Bagger Station	Vacuum, Conveyor	90-91
		Compressed Air	95
	Stacking End of Conveyor	Conveyor	86-87
	Weighing Scale	Conveyor, Compressed Air	86-88
Refrigeration Compressor Area	Area	Equipment	85-95
PVC Loading	Locomotive RE1255	Locomotive	87-92
	Locomotive RE506	Locomotive	80-81
	Area	Dryer Blowers	90-106
Recovery Area	Area	Equipment	79-92
Dryer Area	Area	Blowers, Equipment	87-108

Steam generating plant control rooms were relatively quiet, as expected. Boilers and supporting equipment emitted noise as high as 101 dBA thereby justifying identifying these areas as hazardous noise areas and requiring hearing protection. Noise dosimetry did not show hazardous noise exposures since the employees assigned to this work area do not spend a majority of their working day outside of the control rooms.

There are high noise emissions in the maintenance shops but hazardous noise exposures would not be expected from shop exposures. However, employees do perform tasks throughout the plant and are exposed to other high intensity noises. These employees follow hearing conservation procedures and have hearing protection with them when they move about the plant.

Noise emissions from the PVC Bagging equipment validate the hazardous noise exposures measured with noise dosimeters. Hearing protection must continue in the area of this activity.

Equipment in the Refrigeration Compressor Area and the Recovery Area emit high intensity noise. A hazardous noise exposure was measured in the Recovery Area with noise dosimetry. These areas are posted as hazardous noise areas and hearing protection is required. No further action is required.

The PVC Loading and Dryer areas are affected by the blowers at Dryers # 1 and 3. A high sound pressure level of 108 dBA was measured at the Dryer area. A level of 106 dBA was measured at the Loading area. A test with an octave band analyzer revealed that the pure tone component from the blowers existed in the 500 Hz octave band (a plant engineer indicated during the closing conference that his analysis showed the frequency to be 600 Hz, which is in the 500 Hz octave band). The areas adjacent and near the Dryers have the highest potential to damage hearing with relatively short exposures. These areas are posted as hazardous noise areas and hearing protection is required. Because the sound pressure levels are over 100 dBA, it is recommended that the semi-insert hearing protector not be allowed as hearing protection in these areas. The ear plugs and ear muffs provide a higher level of protection and should be worn in these areas. Sound cancellation technology should be investigated as an effective noise reduction measure at these Dryer blowers.[3]

[3] Ibid.

IV. *Conclusions and Recommendations*

Where exposures were found to be below the applicable exposure limits, existing employee protection strategies were considered to be adequate and no further comments are provided.

A. Noise Exposure

Hazardous noise exposures levels were measured at the Dryers, in the PVC loading area, and at the Bagging machine. Two Dryer blowers emitted a noise level as high as 108 dBA and the Bagging machine emitted 86-95 dBA, as determined by sound-level meter measurement. These areas were designated hazardous noise areas, where hearing protection is required and where signs are posted. Employees were observed wearing proper hearing protection.

Dryer blower noise is the highest noise level encountered during this monitoring survey. The sound emitted is a pure tone at 600 Hz. While pure tone noises are no more damaging to hearing than broad band noise, maximal hearing protection is recommended. Semi-insert ear plugs provide the lowest NRR (22 dB) and the poorest protection. Adjusting protection with OSHA procedures leaves a NRR of 15 dB. Employee exposures remain above 90 dBA with the semi-insert ear plugs. For this area, properly fitted and inserted ear plugs and/or ear muffs are recommended. Efforts to reduce the noise at the blowers or replacing the blowers are the recommended permanent solutions to the hazardous noise problem at the Dryers.

B. Air Sampling

1. PVC Loading

Although high dust exposure levels were not measured, high dust levels were observed during compressed air cleaning. High dust levels can obscure vision, irritate or injure the eyes, and cause slipping and falling. Cleaning with a vacuum system should be investigated.

2. Dryer Operators

Dryer operators were overexposed to PVC dusts (total) during magnet cleaning with compressed air. The IH collecting the air samples noted very high dust entrainment in the environment during this cleaning operation. Air samples validated the observation. Personal protection included single use disposable dust respirators. These respirators provide questionable protection because fit testing is impossible.

Reduction of employee overexposures to dusts during magnet cleaning requires engineering controls and can include a properly fitted NIOSH-certified dust respirator. Single use, disposable respirator use must be discontinued immediately unless the quality of fit can be determined. The process of cleaning the magnets with a vacuum system should be investigated as an engineering exposure control. A vacuum system appears to make more sense because it cleans and collects the PVC resin in a single step.

3. Laboratory Technicians

No overexposures were identified with air samples collected in the QC Lab of the PVC Production Plant. Samples of dioctylphthalate were for the aerosol only; the midget impinger was not used to collect vapors that could be generated by heated dioctylphthalate.

It is recommended that additional sampling in the QC Lab be performed to measure total dioctylphthalate exposures — both aerosol and vapor phases. The air sampling train must consist of a glass fiber pre-filter in line with a midget impinger containing a 50% aqueous isopropyl alcohol solution.

4. Solution Preparation

Not all Solution Preparation exposures were measured during this monitoring survey. It is recommended that employee exposure monitoring continue until all exposures have been measured.

5. AFE Shop — Welding

Tack welding on galvanized metal in the sump pit resulted in the welder being overexposed to zinc oxide and zinc fumes. There was no ventilation in the pit and the welder did not wear a respirator.

This operation will arise infrequently but it reveals the possibility of overexposures during unique tasks. It is recommended that unique tasks be reviewed for possible health consequences and that controls be established before they start. Ventilating the sump would reduce the exposure; a fume respirator, difficult for the welder because of the awkward position that he was in, would also control fume exposure.

C. Area Noise Survey

The area noise survey validated noise overexposures measured with noise dosimetry. The high noise areas noted with sound-level meter measurements validated the hazardous noise area designations and postings observed at the Pasadena Plant. No further recommendations are necessary.

V. *References*

American Conference of Governmental Industrial Hygienists; *Guide to Occupational Exposure Values — 1990*; ACGIH, Cincinnati, OH; 1990.

Sax, Irving N.; *Dangerous Properties of Industrial Materials, Sixth Edition*; Van Nostrand Reinhold Company, New York; 1984; page 1224.

APPENDIX