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Bryan Custom Plastics
Bryan, Ohio

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I. Summary

In August 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Office of the Allied Industrial Workers Union to conduct a health hazard evaluation at the Bryan Custom Plastics (BCP) plant in Bryan, Ohio. The facility produces molded plastic television cabinets and interior automotive door panels. The request indicated that workers were "exhibiting various medical problems including rather severe respiratory distress" believed due to exposures in the spray finishing operation.

In September 1991, NIOSH investigators reviewed company records, conducted private employee interviews, and evaluated the local exhaust ventilation controls for the spray painting operations. The most commonly reported health effects were headaches and upper respiratory symptoms. Workers associated these symptoms with the spray painting process.

Full-shift, personal (breathing zone) and area sampling of spray painting operations conducted during two days in March 1992, for total paint mist, toluene, xylene, ethyl benzene, methyl methacrylate, methyl ethyl ketone, methyl isobutyl ketone, and n-butanol revealed no exposures above NIOSH Recommended Exposure Limits (RELs) or Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). Area carbon monoxide (CO) concentrations up to 34 and 90 ppm (parts per million parts of air) were measured in the spray-finishing areas and quality control respectively.

Environmental monitoring for total airborne particulate, methyl ethyl ketone, methyl isobutyl ketone, toluene, xylene, ethyl benzene, and n-butanol revealed no exposures above evaluation criteria established by the National Institute for Occupational Safety and Health (NIOSH) or the Occupational Safety and Health Administration (OSHA). Area measurements of carbon monoxide concentrations documented the potential for worker overexposure. Recommendations for reducing CO levels and improving work practices are presented in this report.

KEYWORDS: SIC 3089 (plastics molding), spray painting, carbon monoxide, methyl ethyl ketone, methyl isobutyl ketone, total airborne particulate, toluene, xylene, ethyl benzene, methyl methacrylate, and n-butanol.

II. Introduction

In August 1991, NIOSH received a request from the Allied Industrial Workers to conduct a health hazard evaluation at the spray painting operation of Bryan Custom Plastics located in Bryan, Ohio. A number of painters at the plant reported medical problems, including respiratory distress, gastrointestinal symptoms, fatigue, dizziness, and skin irritation. Workers also expressed concerns about exposures to airborne particulate (dried paint), especially during cleanup operations.

The plant has been located in Bryan, Ohio, since 1950, and in the current facility since 1957. The plant operates 2 shifts per day, 5 days per week. There are 32 spray finishers and mixing room employees among 350 production employees. Ninety-eight salaried employees also work at the site. The spray finishing department uses about 80 gallons each of paint and thinner to coat 3,000 door panels and television cabinets each shift. During the course of this evaluation, the company was in the process of replacing their older, low-volume/high-pressure spray guns with high-volume/low-pressure spray guns. This change was expected to lower employee exposures to spray painting chemicals. The company does not require spray finishers to wear respirators. Respirators are made available, but no formal respirator program has been established to provide maintenance and use instructions for employees.

An initial plant visit in September 1991 consisted of employee interviews, record review, and ventilation surveys. In March 1992, a more comprehensive industrial hygiene evaluation was conducted at the facility. During this second visit, additional employee concerns were raised about CO exposure.

A review of the industrial hygiene sampling conducted by the company in the spring of 1991 indicated that the ventilation system in the spray booths was adequately controlling solvent exposures. It does document the existence of CO in the automotive spray paint area where at least one propane-powered fork lift was being used. CO concentrations measured in the automotive area ranged from 17 to 26 ppm (parts analyte per million parts of air), which was attributed mainly to the propane-powered fork lift truck which operates intermittently in the area.

III. Process Description

Plastic television cabinets and interior automotive door panels are manufactured by an extrusion molding process. Workers in the spray finishing department apply a finish coating of lacquer-based paint to furnish a desirable cosmetic luster.

A worker using a propane-powered forklift places boxes of pieces to be painted about 10 feet in front of the spray booths. There are 30 walk-in spray booths, each about 80" tall, 95" wide, and 72" deep. Each booth has an independent exhaust ventilation system. Each spray finisher usually has a helper who assists with final preparations for getting each piece ready to spray.

Spray finishers use about 160 gallons of paint and thinner each day to coat 3,000 panels and cabinets. Half-mask respirators with organic vapor cartridges are available for employees to use. All paints are mixed in a mixing room and piped to the spray booths where workers can attach their sprayer to any of eight color lines. Paint thinners are 50% methyl ethyl ketone and 50% toluene by weight. A central vacuum system at the spray booths may be used for cleanup of dried paint dust. Although the plant has this central vacuum system, the spray finishers sweep up the accumulated overspray on filter banks and other surfaces at the end of their shift of work. Interviews indicated that the central vacuum was not used because it's ineffective if more than one worker is using it simultaneously. Spray booth filters are changed after workers report that the efficiency of the local exhaust is decreasing.

Following painting, the wet pieces are placed onto conveyors and pass beneath electric dryers enroute to the shipping department. One corner of the shipping department is used for quality control (QC).

The entire plant is heated by ceiling-mounted, natural gas, forced air heaters, which are not vented to the outside.

IV. Methods and Materials

ENVIRONMENTAL

Material Safety Data Sheets (MSDS's) were reviewed for the various chemical components of the paint used at this facility. A sampling protocol was developed for the prominent hazardous ingredients.[1] Personal and area sampling of paint spray and mixing operations was conducted. Additionally, CO concentrations were monitored in the spray finishing and quality control areas. All sampling was conducted during normal day shift activities.
Airborne concentrations of the following substances were monitored and analyzed according to the NIOSH Analytical Methods indicated:

Substance	NIOSH Method[2]
total paint mist	0500
elements	7300
toluene, ethyl benzene, xylene	1501
methyl methacrylate	2537
methyl ethyl ketone	2500
methyl isobutyl ketone	1300
n-butanol	1401
carbon monoxide	detector tubes

Each individual analysis has a limit of detection (LOD) and a Limit of Quantification (LOQ). The LOD is a decision point used to report a significant analyte signal from a sample. The LOQ is the smallest amount of analyte which can be measured with precision.[3]

Air sampling for total paint mist was collected to determine the overall effectiveness of the ventilation system in controlling worker exposure.[1] Personal and area samples were collected on polyvinyl chloride (PVC) filters in closed-faced polystyrene cassettes. Area samples were collected at the spray booth face openings. Air was drawn through the PVC filters using Dupont Model P2500 Constant Flow pumps calibrated (pre- and post-sampling) to 2 liters per minute (1/min).

Following the gravimetric analysis for total mass, the collected particulate was further analyzed for elemental metals according to NIOSH Analytical Method 7300[2]. These analyses were to determine if toxic metals (such as chromium, lead, nickel, others) were ingredients in the paints used, and thus constituted additional exposures to be considered.

Full-shift bulk samples for hydrocarbons were collected on charcoal tubes during the March 1992, sampling visit. GilAir Constant Flow pumps, pre- and post-calibrated to 25 cc/minute, were used. The charcoal tube samples were analyzed qualitatively by DataChem Laboratories, Salt Lake City, Utah, to verify the completeness of the sampling strategy.

Full-shift and short-term personal and area samples were also collected for the hydrocarbons listed on the Material Safety Data Sheets (MSDSs), using the dual-lapel sampler tube holders. Using these dual-lapel samplers, samples were collected on workers in the automotive lines, television lines, and in the mixing room. Short-term personal samples were also collected on mixing room personnel to determine their solvent exposures during specific tasks which might subject them to elevated levels for short time periods.

Carbon Monoxide: Short-term area sampling was conducted to measure carbon monoxide concentrations in the quality control and automotive areas. A personal sample was also collected from the automotive area forklift operator. These measurements were obtained using both long and short-term carbon monoxide sampling tubes. In addition, detector tube checks were made throughout the work areas and in the warm air streams emanating from six ceiling heaters.

MEDICAL

In September 1991, confidential interviews were held in person or by telephone with 27 (84%) of 32 spray finish or mixing room employees. Medical records of two employees were reviewed by a NIOSH physician. Company records, including OSHA Form 200 and employee incident reports, were reviewed. Further telephone follow-up interviews were conducted with selected employees in March and April 1992.

V. Evaluation Criteria

Evaluation criteria are used as guidelines to assess the potential adverse health effects of occupational exposures to substances and conditions found in the workplace. These criteria are generally established at levels that can be tolerated by most healthy workers occupationally exposed day after day for a working lifetime without detrimental effects. Because of the variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria.
Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure. Evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

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 adverse health effects. These effects may occur even if the occupational exposures are below the levels set by the evaluation criteria. These combined effects are often not considered in the evaluation criteria. Also, many substances may enter the body by direct contact with the skin and mucous membranes, increasing the overall exposure.

The primary sources of environmental criteria considered in this report are the NIOSH Recommended Exposure Limits (RELs), the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and the OSHA Permissible Exposure Limits (PELs).

The OSHA PELs represent the maximum legal limits to which employees may be occupationally exposed and may be required to take into account the feasibility of controlling exposures in various industries where the agents are used. The NIOSH RELs and ACGIH TLVs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. The exposure criteria are reported as:

- time-weighted average (TWA) exposure recommendations for the full (8-hour) work shift;
- short-term exposure limit (STEL) recommendations for 10-15 minute exposure periods;
- ceiling levels (C) never to be exceeded during the work shift.

These exposure criteria and standards are commonly reported in ppm or milligrams of analyte per cubic meter of air (mg/m^3).

The current OSHA PELs for many of these substances were lowered under the 1989 Air Contaminants Standard, until the 11th Circuit Court of Appeals vacated this standard. OSHA is currently enforcing the pre-1989 PELs, however, some states operating their own OSHA job safety and health programs will continue to enforce the lower limits. OSHA continues to encourage employers to follow the lower limits.

The environmental exposure criteria for the substances monitored during this survey are listed in Table I. Both the enforced and recommended OSHA PELs are listed.

VI. Toxicology

Toluene can affect the body if it is inhaled, ingested, or contacts the eyes or skin. Short term exposure may cause fatigue, weakness, confusion, headache, dizziness, and drowsiness. Skin contact may produce a "pins and needles feeling" or numbness. Repeated or long term exposure to toluene may cause drying and cracking of the skin.[(3)]

Xylene and Ethyl benzene can be absorbed via inhalation, ingestion, and skin or eye contact. Short term exposure may cause irritation of the eyes, nose, and throat. High concentrations of xylene vapor may cause severe breathing difficulty which may be delayed following exposure. High concentrations may also cause dizziness, staggering, drowsiness and unconsciousness. Exposures to high concentrations have been shown to cause reversible damage to the kidneys and liver.[(3)]

Methyl methacrylate can affect the body via inhalation, ingestion, and skin or eye contact. Short-term exposure may cause irritation of the nose, throat, skin, and eyes. It may cause drowsiness and, at very high levels, unconsciousness. Prolonged exposure can cause a skin rash.[3]

Methyl ethyl ketone, also called **2-Butanone or MEK**: MEK may cause health effects following exposure via inhalation, ingestion, and skin or eye contact. Acute exposure can cause headache, dizziness, drowsiness, vomiting, numbness of the extremities, and irritation of the eyes, nose, and throat. Chronic exposure may cause dryness and irritation of the skin.[3]

Methyl isobutyl ketone, also called **Hexone** or **MIBK**, may cause adverse health effects following exposure via inhalation, ingestion, skin, or eye contact. Acute exposure to MIBK can cause nausea, vomiting, headaches, weakness, dizziness, and drowsiness. Chronic exposure can cause dryness, irritation, and inflammation of the skin.[3]

Butanol, also called **Butyl alcohol** can affect the body via inhalation, ingestion, or contact with eyes or skin. Short term exposures may cause irritation of the eyes, nose, and throat, headaches, dizziness, and drowsiness. The overexposed person may experience blurred vision and a burning sensation of the eyes lasting for several days. Long term exposure may cause drying and cracking of the skin.[3]

Since the aforementioned hydrocarbons have similar toxicological effects, the possibility that two or more could act in combination to produce symptoms should be considered (additive effect).

Carbon monoxide (CO): Exposure to CO decreases the ability of the blood to carry oxygen to the tissues. Inhalation of CO may cause headache, nausea, dizziness, weakness, rapid breathing, unconsciousness, and death. High concentrations may be rapidly fatal without producing significant warning symptoms. Exposure to this gas may aggravate heart and artery disease and chest pain in those with pre-existing heart disease. Pregnant women are more susceptible to the effects of CO exposure. The effects are also more severe in people undertaking heavy exercise and in people who are working at high temperatures or altitudes.[3]

VII. Results and Discussion

A. Environmental Evaluation

Bulk air samples

The bulk air sampling showed that the sampling strategy design was appropriate. This qualitative analysis demonstrated that no other hydrocarbons were found with significant presence in the in-plant air.

Air sampling

Total paint mist results are shown in Tables II and III. Levels were monitored full-shift at sixteen area locations, and 15 personal samples were also collected. Levels for these ranged from 0.07 to 2.96 mg/m^3, which indicates acceptable control of worker exposure to paint mist.

The collected airborne particulate was further analyzed for levels of 30 toxic metals using NIOSH Method 7300[2]. Only aluminum, calcium, iron, magnesium, sodium, and zinc were detected. All elements detected were near the LOD (limit of detection), and were well below relevant evaluation criteria.

Hydrocarbon concentrations were monitored in the spray areas and mixing room. Twenty area samples, 14 full-shift personal samples, and 8 short term personal samples were collected at various locations. Tables IV, V, and VI show that area and personal samples for the hydrocarbons tested were well below the NIOSH, OSHA, or ACGIH evaluation criteria. N-butanol and methyl methacrylate concentrations were also sampled, and all results were "none-detected."

Carbon monoxide area samples were collected with long-term tubes and detector tubes in the automotive and QC areas. In addition, a personal sample was collected spanning 1.8 hours for the forklift driver who serviced the automotive area. Six samples in the automotive area ranged from 12 to 34 and averaged 26 ppm. Four detector tube samples in the QC area measured from 70 to 80 ppm during this time period. Five samples in the QC area ranged from 31 to 90 and averaged 61 ppm. The forklift operator's results averaged 28 ppm CO.

While no personal samples were measured for an entire workshift, the potential for employee exposure above the evaluation criteria was clearly documented by the area sampling results.

These levels indicate that a potential health hazard existed for employees working in these areas due to CO exposure. The primary source of CO emissions appears to be the ceiling-mounted, forced air heaters in the QC area. Detector tube checks, made directly in the warm air stream being emitted, found levels of CO in the 70 to 80 ppm range at all three heaters in the QC area. Similar checks at three heaters in other areas of the plant found levels in the 20 to 25 ppm range.

B. Medical Evaluation

Personal or telephone interviews were conducted with 27 of 32 (84%) of spray finish and mixing room employees. Twenty interviewees reported having paint in their noses at the end of their work shift. A wide range of symptoms believed related to the work environment were reported. The most commonly reported health effects were headaches (21) and upper respiratory symptoms (19) including cough, sore throat, sneezing, and allergies worsening at work. Other reported health effects included eye irritation, shortness of breath, chest tightness (attributed to paint fumes), "chemical bronchitis," and sporadic nose bleeds. Several workers reported abdominal distress, including nausea, vomiting, diarrhea, or stomach bloating. Other symptoms included poor appetite and weight loss.

Three spray painters reported feeling "drunk" from paint fumes. Numerous others reported experiencing unusual fatigue at work. Two workers reported dizziness from paint fumes. Additional complaints were that the work area was too hot during the winter of 1991. Two individuals complained of skin irritation. Other complaints included dark urine and decreased sense of smell.

Other than 2 individuals with no complaints, all employees stated their symptoms worsened at work and decreased away from work. The winter/spring of 1991/1992 was generally reported as the time period when symptoms started or worsened. Several persons believed their symptoms were due to the use of new paints introduced in the winter/spring of 1991. Some workers stated their problems decreased during the spring and believed this was due to a policy of more frequent filter changes on the spray booth exhausts.

VIII. Conclusions and Recommendations

Environmental and Medical

1. Plant CO levels should be maintained below the NIOSH REL of 35 ppm TWA. Area CO concentrations up to 34 and 90 ppm were measured in the spray-finishing areas and quality control respectively. Carbon monoxide was judged to have been generated from the ceiling heaters and the internal combustion engines of the fork lift trucks. Accordingly, we recommend monitoring and maintenance of heaters and fork lift trucks for CO emissions, with appropriate corrective action taken to keep worker exposure below the NIOSH REL.

2. Personal observation by NIOSH industrial hygienists indicated the majority of employee exposure to airborne particulate occurred during the final minutes of the shift as employees used brooms to clean up their individual work areas. During the shift, the highest levels of airborne particulate ranged between 1-3 mg/m^3, and most of that appeared to accumulate during cleanup operations. Day-to-day changes in work practices and fluctuations in the volume of product handled could result in even higher levels. This particulate is predominantly dried paint mist and may contain solvent and other residues which could adversely affect the health of spray finishers through respiratory and dermal (skin) exposures.

   Accordingly, we recommend use of the central vacuum system to clean-up work areas. This will allow the paint residue and overspray to be collected without being re-entrained into the workplace air, further exposing employees to airborne particulate during the clean-up operations. Use of the central vacuum cleaner should be rotated to allow employees individual use of the equipment, and the system's power could be increased to make it more effective for clean-up operations.

3. Based upon sampling data collected during our site visit, airborne hydrocarbon concentrations at BCP did not pose a health hazard for employees in the spray finishing and mixing areas. However, if employees do choose to wear respirators, then a respiratory protection program consistent with the requirements of OSHA standard 29 CFR 1910.134 should be followed.[(4)]

   Exposed skin areas are a potential route of entry into the body for contaminants. It is possible that some employee symptoms could be the result of skin exposure to paint and solvents. Appropriate protective clothing should be worn by all employees with potential skin exposure to paint and solvents. Such protective clothing would help prevent both skin irritation and absorption of paints and solvents.

   A third route of entry into the body for these hydrocarbons is ingestion. It is possible (though less likely) that some symptoms could be the result of ingestion of paint and solvents. Accordingly, we recommend no eating, drinking, smoking, or applying makeup in the work areas to reduce exposure through ingestion. Spray finishing employees should be trained and encouraged to wash hands and face thoroughly before eating, drinking, smoking, or applying makeup.

4. Spray booth filters should be changed routinely to maintain the efficiency of the exhaust ventilation system. A log of such changes should be created and maintained. Alternately, manometers should be installed on all spray booths and the spray finishers trained in reading

these instruments, so that each spray finisher can easily decide (by reading the pressure drop across the filters) if the filters are due to be vacuumed or replaced.

5. A system should be established and employees should be encouraged to record work-related health complaints.

6. Review the hazard communication program (29 CFR 1910.1200) to assure that the program provides these elements:

   (1) a written description of the program;

   (2) a complete list of all hazardous chemicals present;

   (3) a labeling system for all hazardous chemicals;

   (4) an organized system of MSDS for all hazardous chemicals; and

   (5) employee information and training to acquaint workers with:
      (a) the elements of this hazard communication program
      (b) operations in their work areas where hazardous chemicals are present
      (c) the labeling system used at the facility
      (d) the location and availability of MSDS
      (e) methods and observations to detect the presence or release of hazardous chemicals.
      (f) the physical and health hazards of chemicals in their work areas
      (g) specific measures employees can take to protect themselves from chemical hazards.

IX. References

1. O'Brien DM, Hurley DE [1981]. An Evaluation of Engineering Control Technology for Spray Painting. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH), Publication No. 81-121.

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6. ACGIH [1993]. Guide to Occupational Exposure Values. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

X. Authorship and Acknowledgements

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Copies of this report have been sent to:

1. Employee Involvement Manager, Bryan Custom Plastics, Inc.
2. President, Allied Industrial Workers Union, BCP Local 141.
3. Director, Region III, Allied Industrial Workers
4. OSHA Region V Offices.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I
Evaluation Criteria
Bryan Custom Plastics
Bryan, Ohio
HETA 91-0341

Analyte	NIOSH REL[5]	ACGIH TLV[6]	OSHA PEL[4] ENFORCED	OSHA PEL[4] RECOMMENDED
carbon monoxide	35 ppm TWA 200 ppm C	25 ppm TWA	50 ppm TWA	35 ppm TWA 200 ppm C
ethyl benzene	100 ppm TWA 125 ppm STEL	100 ppm TWA 125 ppm STEL	100 ppm TWA	100 ppm TWA 125 ppm STEL
methyl methacrylate	100 ppm TWA	100 ppm TWA	100 ppm TWA	100 ppm TWA
methyl isobutyl ketone	50 ppm TWA 75 ppm STEL	50 ppm TWA 75 ppm STEL	100 ppm TWA	50 ppm TWA 75 ppm STEL
methyl ethyl ketone	200 ppm TWA 300 ppm STEL	200 ppm TWA 300 ppm STEL	200 ppm TWA	200 ppm TWA 300 ppm STEL
n-butanol	50 ppm C	50 ppm C	100 ppm TWA	50 ppm C
toluene	100 ppm TWA 200 ppm STEL	50 ppm TWA	200 ppm TWA 300 ppm(10-minute STEL) 500 C	100 ppm TWA 150 ppm STEL
xylene	100 ppm TWA 150 ppm STEL	100 ppm TWA 150 ppm STEL	100 ppm TWA	100 ppm TWA 150 ppm STEL

- ppm denotes parts analyte per million parts of air
- TWA denotes 8-hour time-weighted average
- STEL denotes short term exposure limit
- C denotes a ceiling limit not to be exceeded for any time

Table II
Personal Sampling for Total Paint Mist
Bryan Custom Plastics
Bryan, Ohio
March 4-5, 1992
HETA 91-0341

Location of spray finishers	**Exposure in mg/m^3**	**m^3 sampled**	**1992 Date**
Booth 1	1.65	0.873	3/4
Booth 2	0.82	0.870	3/4
Booth 12	0.95	0.930	3/4
Booth 14	0.32	0.807	3/4
Booth 15	0.05	0.614	3/4
Booth 16	1.63	0.906	3/4
Booth 18	0.38	0.894	3/4
Booth 1	1.31	0.832	3/5
Booth 2	2.96	0.934	3/5
Booth 3 and 10	0.55	0.990	3/5
Booth 12	1.36	0.938	3/5
Booth 15	1.09	0.707	3/5
Booth 16/14	1.95	0.904	3/5
Booth 19	0.70	0.932	3/5
Booth 20	0.37	0.600	3/5

mg/m^3 - milligrams analyte per cubic meter of air
LOQ - 0.01 mg/m^3

Table III
Area Sampling for Total Paint Mist
Bryan Custom Plastics
Bryan, Ohio
March 4-5, 1992
HETA 91-0341

Location	**Exposure in mg/m^3**	**m^3 sampled**	**1992 Date**
Auto Rm-E	1.42	0.844	3/4
Auto Rm-SE	0.10	0.979	3/4
Auto Rm-W	0.07	1.008	3/4
Booth 1	0.08	1.082	3/4
Booth 3	0.54	0.870	3/4
Booth 16	0.36	1.002	3/4
Booth 16	0.20	0.993	3/4
Booth 16	0.75	0.279	3/4
Booth 16	0.30	0.707	3/4
Booth 28	0.11	1.103	3/4
Mix Rm.	0.10	1.047	3/4
Remote	0.03	1.116	3/4
Auto Rm-W	0.19	1.079	3/5
Booth 1	0.10	1.061	3/5
Booth 28	0.22	1.023	3/5
Mix Rm..	0.15	1.018	3/5

mg/m^3 - milligrams analyte per cubic meter of air
LOQ - 0.01 mg/m^3

Table IV
Hydrocarbon Area Sampling Results
Bryan Custom Plastics
Bryan, Ohio
March 4-5, 1992
HETA 91-0341

Location	Toluene ppm	Xylene ppm	Ethyl Benzene ppm	MEK ppm	MIBK ppm	volume (m^3)	1992 DATE
Automotive Room - east	2.4	0.9	↓ LOQ	ND	ND	0.012	3/4
Automotive Room - southeast	2.9	1.3	↓ LOQ	ND	ND	0.012	3/4
Automotive Room - west	1.7	0.8	ND	ND	ND	0.012	3/4
Booth 1	↓ LOQ	↓ LOQ	ND	ND	ND	0.013	3/4
Booth 3	2.3	0.8	↓ LOQ	↓ LOQ	ND	0.014	3/4
Booth 16	5.9	2.4	↓ LOQ	ND	ND	0.013	3/4
Booth 28	5.4	0.8	↓ LOQ	6.0	ND	0.014	3/4
Mixing Room	3.7	↓ LOQ	ND	1.4	ND	0.013	3/4
Mixing Room	5.1	0.8	↓ LOQ	5.2	ND	0.013	3/4
Remote in J.Hyde's office	ND	ND	ND	ND	ND	0.014	3/4
Automotive Room -east	3.3	1.3	↓ LOQ	2.6	↓ LOQ	0.013	3/5
Automotive Room - southeast	2.6	0.8	ND	ND	ND	0.013	3/5
Automotive Room - west	2.0	0.8	ND	↓ LOQ	ND	0.012	3/5
Booth 1	↓ LOQ	↓ LOQ	ND	ND	ND	0.013	3/5
Booth 5	1.5	↓ LOQ	↓ LOQ		ND	0.013	3/5
Booth 16	4.1	1.8	↓ LOQ		ND	0.014	3/5
Booth 28	3.3	↓ LOQ	ND	4.9	ND	0.013	3/5
Mixing Room	3.3	↓ LOQ	ND	2.9	ND	0.013	3/5
Mixing Room	3.4	↓ LOQ	ND	3.4	ND	0.013	3/5
Remote in J.Hyde's office	ND	ND	ND	ND	ND	0.011	3/5
LOQ (Limit of Quantification)	**0.8**	**0.6**	**0.6**	**0.8**	**0.6**		

- "C" denotes a ceiling value, not to be exceeded for any length of time
- ↓ LOQ denotes that some level of analyte was detected, but less than could be quantified
- ND denotes none detected

Table V
Short-term Hydrocarbon Personal Sampling Results
Bryan Custom Plastics
Bryan, Ohio
March 4-5, 1992
HETA 91-0341

Activity of sampled individual	Toluene ppm	Xylene ppm	Ethyl Benzene ppm	n-Butanol ppm	MEK ppm	MIBK ppm	volume (m^3)	Time (minutes)	1992 DATE
Booth 5: spraying television cabinets	↓ LOQ	ND	ND	↓ LOQ		ND	0.003	15	
Mixing Room: mixing currant Red, pumping 3595A solvent, cleaning mixer, checking temperature	8.0	↓ LOQ	ND	ND		ND	0.003	15	3/4
Distiller Area: removing waste solvents from distiller and performing other maintenance tasks	↓ LOQ	ND	ND	ND	ND	ND	0.002	7	3/4
Mixing Room: cleaning solvent distiller	↓ LOQ	ND	ND	ND		ND	0.001	5	3/4
Mixing Room: checking paint viscosity and color correctness	↓ LOQ	ND	ND	ND		ND	0.003	15	3/4
Mixing Room: cleaning quart-size sprayer cup, checking paint viscosities and temperatures, adding 3595 thinner, and running 30-sec. test spraying with Currant red	↓ LOQ	ND	ND	ND		ND	0.002	9	3/5
Mixing Room: cleaning distiller and changing paint color	7.3	1.4	ND	ND		ND	0.007	30	3/5
Mixing Room: checking colors for quality control; mixing and sampling paints	4.9	↓ LOQ	ND	ND		ND	0.006	28	3/5
LOQ (Limit of Quantification)	0.8	0.6	0.6	0.8	0.8	0.6			

NOTES:
- ↓ LOQ denotes that some level of analyte was detected, but less than could be quantified
- ND denotes none detected

Table VI
Full-shift Personal Hydrocarbon Sampling Results
Bryan Custom Plastics; Bryan, Ohio
March 4-5, 1992
HETA 91-0341

Occupation	Toluene ppm	Xylene ppm	Ethyl Benzene ppm	n-Butanol ppm	MEK ppm	MIBK ppm	volume (m^3)	1992 DATE
Booth 5 painter	5.9	1.5	↓LOQ	ND		ND	10.4	3/4
Booth 13 painter					↓LOQ	ND	11.4	3/4
Booth 19 painter							11.1	3/4
Booth 28 painter	6.5	0.8	ND	ND	9.7	↓LOQ	12.3	3/4
Mixer					2.3	ND	10.5	3/4
Mixer					2.0	ND	12.5	3/4
Mixer					6.6	↓LOQ	10.2	3/4
tv line loader	ND	ND	ND	ND	↓LOQ	ND	6.1	3/4
Booths 5, 15, 5 painter	3.7	1.0	↓LOQ	2.0		ND	11.0	3/5
Booth 13 painter					↓LOQ	ND	12.3	3/5
Booth 15 painter	2.6	1.0	↓LOQ	ND		ND	12.4	3/5
Booth 18 painter	ND						11.5	3/5
Booth 28 painter					9.1	↓LOQ	12.0	3/5
Mixer					4.9	ND	12.6	3/5
LOQ (limit of Quantification)	0.8	0.6	0.6	0.8	0.8	0.6		

NOTES:

- mg/m^3 is milligrams analyte per cubic meter of air
- "C" denotes a ceiling value, not to be exceeded for any length of time
- ↓ LOQ denotes that some level of analyte was detected, but less than could be quantified
- ND denotes none detected