HEALTH HAZARD EVALUATION REPORT 72-12-26
HAZARD EVALUATION SERVICES BRANCH
DIVISION OF TECHNICAL SERVICES

Establishment : Sun Products Corporation
Barberton, Ohio

Evaluation Conducted By : Melvin T. Okawa, Industrial Hygienist
Howard R. Ludwig, Industrial Hygienist
Steven K. Shama, M.D., Medical Officer
Robert N. Ligo, M.D., Medical Director
John M. Peters, M.D., Consultant, Harvard University

Report Prepared By : Melvin T. Okawa, Industrial Hygienist
Steven K. Shama, M.D., Medical Officer

Originating Office : Jerome P. Flesch
Chief, Hazard Evaluation Services Branch

January 1973

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION REPORT 72-12-26
SUN PRODUCTS CORPORATION
BARBERTON, OHIO

JANUARY 1973

I. SUMMARY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to isocyanates, paint sprays, solvents, and dust at the Sun Products Corporation plant in Barberton, Ohio.

NIOSH investigators conducted environmental-medical evaluations of the associated operations on March 22-23 and July 12, 16, 1972. Ten (10) personnel and thirteen (13) general area samples for airborne concentrations of toluene-2,4-diisocyanate (TDI) were collected in the foam line areas of the plant. TDI was not detected in any of the samples except for one taken in the breathing zone of a foam machine operator on the #2 foam line (horn hub assembly). The level of TDI in this sample was 0.004 mg/M^3 which is well below the established standard of 0.14 mg/M^3 (ceiling concentration) promulgated by the U.S. Department of Labor (Federal Register, Part II, §1910.93, Table G-1). Seventeen employees, with exposure to areas where TDI is used, were interviewed regarding symptoms associated with TDI. Based on all of the available information, it was determined that under the present conditions, TDI does not constitute a health hazard. However, specific recommendations have been made to management regarding the medical monitoring of all personnel exposed to TDI.

Eleven (11) personnel samples for solvent vapors of acetone, toluene, xylene, and methyl ethyl ketone (MEK) were collected in the paint and lacquer spraying, arm rest washing, and paint shack areas of the plant. Most of the solvent levels measured were well below

established standards. Only one sample exceeded an established standard; an MEK level of 210 ppm (standard - 200 ppm) was measured in the arm rest washing area. Levels measured with associated standards were:

Acetone	Ranged	<50 - 208	(Standard 1000 ppm)
Xylene		< 5	(Standard 100 ppm)
Toluene	Ranged	< 5 - 9.0	(Standard 200 ppm)
MEK	Ranged	< 5 - 210	(Standard 200 ppm)

Since employees are in the area for a full shift, although they had no symptoms compatible with excessive exposure to MEK, specific control measures have been recommended to management to obviate the borderline health hazard from MEK in the arm rest washing area.

Noise measurements were taken in the rotational casting and furnace areas of the plant. Noise levels were in excess of the established standard (Federal Register, Part II, §1910.95, Table G-16) near rotational casting machines #1-4. Specific recommendations to obviate the noise hazard in this area have been made to management.

Copies of this Summary Determination as well as the Full Report of the evaluation are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th & Walnut Streets, Cincinnati, Ohio 45202. Copies of both have been sent to:

a) Sun Products Corporation plant, Barberton, Ohio
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region V

For purposes of informing the approximately 213 "affected employees" who work in the manufacturing area, the employer will promptly "post" the Summary Determination in a prominent place(s) near where affected employees work for a period of 30 calendar days.

II. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to isocyanates, paint spray, solvents, and dust at the Sun Products Corporation plant in Barberton, Ohio.

III. BACKGROUND HAZARD INFORMATION

A. Standards

The occupational health standards promulgated by the U.S. Department of Labor (Federal Register, Part II, §1910.93, Table G-1) applicable to substances of this evaluation are as follows:

(1)	Toluene-2,4-diisocyanate	0.14	mg/M^3*
(2)	Methyl ethyl ketone	200	ppm **
(3)	Acetone	1000	ppm
(4)	Toluene	200	ppm
(5)	Xylene	100	ppm
(6)	Noise	See Table IV	

B. Toxic Effects

Toluene-2,4-diisocyanate (TDI) is a well known respiratory irritant, in some cases producing serious allergic reactions in the lungs. Typical mild symptoms of TDI exposure are those due to mucosal irritation, itchiness of the eyes, congestion of the nose, and a dry throat accompanied by a throbbing headache. Greater exposure can cause a severe dry cough, mild chest pain with tightness in the chest.[1] The allergic reaction from exposure to TDI may occur in sensitized individuals with extremely small quantitites of TDI in the atmosphere (below the Federal Standard) and manifest itself usually with asthmatic symptoms.

---

* mg/M^3 - milligrams of substance per cubic meter of air

** ppm - parts of vapor per million parts of contaminated air by volume at 25°C and 760 mm of Hg pressure.

Acetone is not extremely hazardous under normal industrial handling practices. It is low in oral acute toxicity, is slightly irritating to the skin even after severe exposure, and is moderately irritating to the eyes. It is slightly toxic when inhaled in high concentrations, causing narcosis but no serious systemic injury. The principle hazards to health from acetone are associated with the inhalation of vapors at high concentrations and with repeated and prolonged skin contact.[2]

Methyl ethyl ketone (MEK) has a low acute oral toxicity. The liquid may produce moderate skin irritation if the exposure is frequent and prolonged. MEK vapors may cause marked irritation of the eyes and mucous membranes. At concentrations above 300 ppm, inhalation of MEK may cause headaches, throat irritation, and other similar symptoms.[2]

Toluene is considered to be a significant narcotizing substance and exposures should be controlled. As concentrations of toluene in the air increase above 200 ppm, the exposed person can experience fatigue, mental confusion, exhilaration, nausea, headache, and dizziness. With exposure to 800 ppm, these symptoms are more pronounced and can last for several days.[2]

The observed effects of exposures to xylene, the mechanisms of action, and the pathological changes in acute xylene intoxication are similar to those described for toluene.[2]

Exposures to intense noises may lead to a loss in hearing which may be temporary or permanent. Loss of hearing will be noted by a measured shift in the hearing threshold. When recovery to normal hearing thresholds occurs, the shift is known as "temporary." When full recovery does not occur, the shift is known as "permanent." Not all persons are susceptible to hearing loss at the same noise level. Therefore, it is not possible to set up a simple relation between hearing loss and noise level. However, standards have been established to protect the majority of the people.

IV. HEALTH HAZARD EVALUATION

A. Initial Visit - Observational Survey

The initial observational survey of the Sun Products Corporation plant was made on March 22, 1972, by the National Institute for Occupational Safety and Health (NIOSH) representatives Messrs. Melvin T. Okawa and Howard R. Ludwig and Drs. Steven K. Shama and Robert Ligo. The purpose of our visit was explained to ~~Mr. Paul Matas~~, the Assistant to the President.

After completing the NSN Part I questionnaire with ~~Mr. Matas,~~ he accompanied us through the manufacturing areas of the plant which are contained in one building but separated by type of operation. We met briefly with the employees' representative, but she did not wish to accompany us during the observational survey.

The Sun Products plant is a producer of toys, athletic goods, and industrial contract parts made by molding of plastics. The liquid vinyl plastisols and plastic molding compounds are poured into molds and are cast into the final products by a plastic molding process called rotational casting. After removal from molds, the products undergo further modification and final inspection before being stocked or shipped to customers. Approximately 213 persons are employed in the manufacturing area at the Sun Products plant. Three shifts per day are worked although all operations are not running during the second and third shifts.

Compounding Area

The various plastisols and plastic molding compounds are formulated in this section of the plant. A number of mixing vats are located here, and such compounds as resins, fillers, and dyes are added to the mixers by hand. Under normal working conditions, the potential for occupational health hazards in this area is relatively low. Standard precautions and good housekeeping should be adequate to control potential hazards in this area.

Manufacturing Area

The company manufactures head and arm rests for automobiles as one of their contract products in addition to their major line of toys. After the head and arm rest shells are cast in the plastics manufacturing area, they are brought to the foam line area where a foam mixture is added to the shells. This foaming agent is polyurethane which is associated with potential exposure to toluene diisocyanate (TDI). After the pouring machine fills the head and arm rests with foam, they are sent on a continuous conveyor belt to an oven where they are cured. The pieces are then removed for trimming and cleaning. The excess foam is trimmed off by workers using grinding wheels. The head and arm rests are conveyed over to a washing area to be cleaned by hand with solvents, and finally, are lacquered in a spray booth and packed for shipment.

The potential occupational health hazards were judeged to be TDI, and solvent vapors of acetone, toluene, xylene, and methyl ethyl ketone (MEK).

Plastics Manufacturing Area

This section of the plant contains the rotational casting machines and the paint spraying equipment used in decorating the major line of toys. Each casting machine is handled by 1-3 employees. Compressed air wrenches are standard equipment used for tightening and loosening nuts and bolts on the casting molds. The noise levels from this operation seemed high. Toys were decorated inside of spray booths and the potential for paint and solvent exposure seemed low.

Athletic Equipment Decorating Area

Footballs and basketballs are decorated in this section of the plant. This operation was not running during our visit and could not be evaluated. Paints and solvents are used in spray booths. Their effectiveness could not be evaluated because this section operates on a periodic basis only.

Paint Shack

A small building is located outside the main plant where all of the paints and lacquers are mixed and stored. There is not mechanical ventilation in the building and potential hazards were judged to be fire and exposure to solvents. One employee handles the entire operation.

B. Environmental Evaluation

1. Procedure and Methods

On March 22 and 23, 1972, a health hazard survey was conducted by Messrs. Melvin T. Okawa and Howard R. Ludwig to determine environmental exposures to workers for TDI, paint and lacquer solvents, and noise. Additionally, Mr. Ludwig conducted further studies for TDI on July 12, 1972.

On March 22 and 23, six (6) personnel breathing zone and nine (9) general area samples for TDI were collected in the foam line areas in the manufacturing section. The breathing zone and general area samples were collected with the same type of instruments. MSA Model G battery operated pumps were used to draw air through midget impingers containing 10 millimeters of acid absorbing solution at a rate of 1.7 liters per minute. Sampling times ranged from 10 - 30 minutes. On July 12, four (4) personnel breathing zone and four (4) general area samples for TDI were collected. Much longer samples were taken during the second survey. Sampling times ranged from 117-176 minutes and the sampling rate was 1.7 liters per minute. Analysis of TDI samples was according to the Marcali method.

On March 22 and 23, eleven (11) personnel breathing zone samples were taken for various solvents in paint, lacquer, and washing operations throughout the plant. Air was drawn through special charcoal tubes at a rate of 1.0 liters per minute by MSA Model G battery operated pumps. Sampling times ranged from 10-17 minutes.

On March 23, noise measurements were taken in the rotational casting areas of the plant with General Radio Company Type 1565-B sound level meters.

2. Results

The TDI samples were analyzed by the Western Area Occupational Health Laboratory, NIOSH, Salt Lake City, Utah. Results of the analysis in milligrams of TDI per cubic meter of air sampled (mg/M^3) are contained in Table I.

The established standard for TDI (Federal Register, Part II, §1910.93, Table G-1) promulgated by the U.S. Department of Labor is 0.14 mg/M^3. This value is a ceiling concentration not to be exceeded at any time. From Table I, it can be seen that all the samples except one are less than (/) a certain stated value. For example, / 0.025 means that the TDI in that sample was less than 0.025 mg/M^3 but how much less is not certain because TDI was not detected for the volume of air sampled. The value 0.025 mg/M^3 is a calculated number based on the volume of air sampled. There would have to be at least 0.025 mg/M^3 of TDI in the sample before the laboratory can detect it. As the sample air volume gets larger, this number becomes smaller until some endpoint of detection is reached. TDI was not detected in any of the samples in the initial survey. It was decided to sample for longer time periods in a repeat survey in July. TDI was detected in only one sample taken in the number 2 foam line. This sample was collected in the breathing zone of a TDI foam machine operator and the TDI concentration was 0.004 mg/M^3. This level is well below the federal standard of 0.14 mg/M^3.

The charcoal tube samples for methyl ethyl ketone (MEK), toluene, acetone, and xylene were analyzed at NIOSH laboratories in Salt Lake City, Utah. The results are contained in Table II, and it can be seen that in the arm rest washing area, levels of MEK can, at one time, exceed the established standard of 200 ppm (Federal Register, Part II, §1910.93, Talbe G-1). Concentrations of other solvents were well below their respective established standards. Two samples were taken in the arm rest washing area. The concentrations of MEK were 210 ppm and 153 ppm.

A General Radio sound level meter was used to check noise levels in the casting area of the plant. It has been determined that "substances" as presently defined in Section 20(a)(6) of the Act do not include physical agents. However, for completeness of our overall responsibilities for acknowledging any occupational hazards encountered during the course of an health hazard evaluation, these findings are reported.

The results of the noise survey are contained in Table III and the established noise standard is listed in Table IV. Most of the rotational casting machines have two men operating them. Compressed air lug wrenches and cleaning jets are used at set intervals during one complete cycle of the casting machine. Noise levels and their time durations were noted with the sound level meter and a stop watch.

Table III contains C_n/T_n ratios and the noise levels in decibels (A-weighting network at slow response) for rotational casting and furnace operations. If the sum of the following fractions: $C_1/T_1 + C2/T_2 \ldots C_n/T_n$ exceeds unity, then, the mixed noise exposure is considered to be in excess of the limit value. The noise exposure in the casting and furnace areas is generally composed of two or more periods of noise at different levels. Noise levels were in excess on the limit value where employees work near rotational casting machines 1-4. Noise levels approached the limit value near furnace #17. Other areas surveyed were not excessively noisy.

3. Summary and Conclusions

Environmental surveys of the rotational casting, foam line, paint spraying, solvent washing, and lacquer spraying operations were conducted at the Sun Products Corporation plant in Barberton, Ohio. TDI was detected in only one sample (0.004 mg/M^3). This value was well below the established standard of 0.14 mg/M^3 (ceiling concentration) promulgated by the U.S. Department of Labor (Federal Register, Part II, §1910.93, Table G-1).

Environmental surveys for solvent vapors of acetone, toluene, xylene, and methyl ethyl ketone (MEK) were conducted in the paint spraying, lacquer spraying, and solvent washing areas. Solvent levels in most areas were well below established standards. In one area of the plant (arm rest washing), an MEK level was found to be 210 ppm in one sample. This result is in excess of the established standard of 200 ppm (8-hour time-weighted average) promulgated by the U.S. Department of Labor (Federal Register, Part II, §1910.93, Table G-1). Because workers are in this area for a full shift, it is concluded that a borderline health hazard from MEK exists under the present working conditions. No hazards presently exist from lacquer or paint sprays in the plant.

Noise measurements were conducted in the rotational casting and furnace areas of the plant. Measured noise levels at rotational casting machines 1-4 were in excess of the established standard (Federal Register, Part II, §1910.95, Table G-16) and constitute a potential hearing loss hazard. Noise levels approached the standard near furnace #17 while other areas of the plant were not in excess of the allowable limits for noise.

C. Medical Evaluation

1. Procedure and Methods

On March 22, 1972 a preliminary medical survey was conducted by Drs. Robert N. Ligo and Steven K. Shama, NIOSH physicians. Employee interviews were conducted with all twelve workers on the TDI foam line, including two workers intimately involved with the machine injecting the TDI into molds. In addition, five workers who sometimes walk through the TDI area but who do not work there were interviewed. Additionally on July 16, 1972 a follow-up medical survey was conducted by Drs. Ligo and Shama and NIOSH consultant, Dr. John Peters. (Medical questions centered around respiratory difficulties) Ten workers exposed to MEK, lacquers and paint sprays were also questioned.

2. Results

a. TDI: The two men who work directly with machines injecting TDI into molds denied symptoms of respiratory irritation and, in fact, did not admit to any discomfort while working around the machines. The ten remaining workers noted mild nose and throat irritation when applying petroleum naptha lubricant to the molds at the beginning of the cycle.

The president of the local union referred us to a group of five workers who do not work on the TDI foam lines but who sometimes pass through the area. One worker noted "shortness of breath" when walking near the TDI area; he denied these symptoms on weekends. A second person admitted to his bronchial tubes "closing up" when passing near the foam lines but has no problems at home. A third said that he has had "bronchial asthma" for about five years and that his condition started while he was working on the foam line.

b. MEK: No workers exposed to MEK admitted to being symptomatic.

c. Lacquering and Paint Spray Areas: Ten workers in spraying areas admitted to occasional symptoms of upper respiratory irritation and headaches prior to ventilation changes. No symptoms were noted by workers after the improvements.

3. Discussion

a. TDI is a well known respiratory irritant, in some cases producing serious allergic reactions in the lungs. Typical mild symptoms of TDI exposure are those due to mucosal irritation; itchiness of the eyes, congestion of the nose and a dry throat accompanied by a throbbing headache. Greater exposure can cause a severe dry cough, mild chest pain with tightness in the chest.[1] The capacity of TDI to produce allergic sensitization of the respiratory tract in man is its most serious toxicologic action which determines the magnitude of the threshold limit value.[3] However, allergic reaction from exposure to TDI may occur in sensitized individuals with extremely small quantitites of TDI in the atmosphere, (well below the Federal Standard) and manifest itself usually with asthmatic symptoms. Workers having known respiratory condition such as asthma, chronic bronchitis, emphsema or previous allergic reaction to TDI should be screened out for work in TDI areas.[4]

It is possible that workers not working in the TDI foam line but who were symptomatic may be suffering from a hypersensitivity reaction to TDI. If a hypersensitivity reaction is the case no amount of ventilation change is realistically possible to avoid a reaction and avoidance of walking through foam line areas is indicated. Considering workers working on the TDI foam line who have mild upper respiratory irritation usually when petroleum naptha vaporizes from the mold, they are probably being exposed to the irritative vapors of petroleum naptha rather than the TDI vapors.

Results of the initial industrial hygiene air sampling for TDI in March indicated levels no greater than one-third the Federal Standard. Because of recent published evidence by Peters[5,6,7,8] that workers may be experiencing changes in lung function at levels below the present standard, a repeat air survey was performed increasing sample air volumes to detect much smaller concentrations of TDI than the original air sampling. In addition, on July 16, 1972, Dr. Peters toured the plant as our consultant. The repeat air survey revealed air concentrations of TDI less than one twentieth the standard. Dr. Peters concluded that under the conditions which we toured the plant, and taking into consideration the small TDI concentration measured, a health hazard related to isocyanates does not exist. Even in cold weather with windows and doors closed (implying poorer ventilation) it is unlikely that TDI levels would rise to a hazardous level.

b. MEK: Industrial exposures to MEK are those of inhalation, skin and eye contact. MEK is primarily a mucous membrane irritant. The liquid form may produce moderate skin irritation if exposure is frequent and prolonged. Inhalation or eye contact may result in mild symptoms of nose, throat or eye irritation. No symptoms were noted by any exposed workers.

The slight elevation of MEK levels in some samples should not be considered a serious hazard but efforts should be made to improve ventilation and reduce levels below the Federal Standards.

c. Lacquers and Paint Spray: In general, occasional exposure to lacquers and paint sprays may cause nose and throat irritation and headaches. The effects are transient.

4. Summary and Conclusions

Seventeen workers with exposure to TDI were interviewed. Twelve of them were working on the foam lines and had the greatest and longest contact with TDI. Of these workers, some admitted to mild nose and throat irritation at times when petroleum naphtha was vaporized, implicating petroleum naphtha as the offending agent. of five workers not employed in the foam line area but passing through it, three admitted to symptoms consistent with a respiratory irritant, possible TDI.

Taking into consideration the current medical knowledge regarding the effect of TDI on the respiratory tract, and the low environmental levels of TDI measured at the plant, the alleged hazard to TDI exposure does not exist; however, there do appear to be workers walking through the TDI area who are symptomatic. These workers should by-pass this area avoiding exposure to whatever irritating substance is causing the difficulties to these few individuals. The workers on the TDI line who are symptomatic appear to be exposed to vapor of petroleum naptha (used to lubricate the molds) from hot molds. The hexane component of petroleum naptha has been known to cause irritation of the eyes, nose and throat.[8]

Specific recommendations regarding medical monitoring of workers exposed to TDI are made in the recommendation section of this report.

The elevated MEK level constitutes a borderline hazard. Ventilation improvements should reduce levels. No hazard presently exists in the paint spray and lacquer areas.

V. RECOMMENDATIONS

1. Normal precautions for handling the TDI portion of the foam mixture should be strictly followed. If a spill occurs with TDI, workers who perform the clean-up should use an approved respirator.

2. All handling procedures for TDI should be made evident to workers through normal channels such as safety committee meetings.

3. The current practice of disqualification from jobs involving TDI exposure should be continued for new workers or old workers giving a significant history of asthma, chronic bronchitis, emphysema or previous allergy to TDI.

4. A chest x-ray should be given to all employees yearly who are exposed to TDI.

5. A forced vital capacity (FVC) and a forced expiratory volume in one second (FEV_1) should be done routinely on all new and old employees who are exposed to TDI. Workers scoring below normal on these pulmonary function studies should be disqualified from jobs involving TDI exposure.

6. Employees who are working in other areas of the plant who show symptoms when entering TDI areas should avoid these areas.

7. Environmental monitoring for TDI should be done if the present TDI process is changed or modified or if unusual changes in the medical monitoring program results are noted.

8. Local exhaust ventilation should be designed for the arm rest washing area where MEK is applied by hand. Approved respirators should be worn or increased rotation of workers in this area should apply until engineering controls are installed. Also, workers applying solvents by hand should wear protective gloves.

9. Efforts should be made to substitute a less irritating compound than petroleum naphtha in the lubricant or general dilution ventilation should be increased in areas where the petroleum naphtha can vaporize.

10. Ear protection should be worn by employees working on rotational casting machines 1-4 and on furnace #17. If feasible, noise dampening controls should be designed for the compressed air accessories currently being used with these machines.

11. A hearing conservation program which includes periodic audiometric monitoring of employees should be established for all workers in the rotational casting area.

VI. REFERENCES

1. Brugsch, H.G.; Elkins, H.G.: New Eng. J. Med. 263, 1963, p. 353.

2. Industrial Hygiene and Toxicology, Second Revised Edition, Vol. II, Frank A. Patty, Editor, 1963, Interscience Publishers, New York.

3. Documentation of the Threshold Limit Values, American Conference of Governmental Industrial Hygienists, 3rd Edition, 1971, Cincinnati, Ohio.

4. Safety Data Sheet 489: Revision A, National Safety Council, 1968.

5. Peters, J.M., Murphy, et al: Arch. Environ. Health 16, 642 (1968).

6. Peters, J.M., Murphy, R.L.H.; Ferris, B.G.: Brit. J. Ind. Med. 26, 115 (1969).

7. Peters, J.M., Murphy, R.L.H: Arch. Environ. Health 20, 364 (1970).

8. Peters, John. Acute and Long-Term Effects of Exposure to Isocyanates. Presented at American Conference of Governmental Industrial Hygienists (ACGIH) Conference, May 16, 1972.

Table I. Concentrations Of TDI In Air Samples Collected At The Foam Line Operation Of The Sun Products Corporation Plant

Sample No.	Operation/Location	Sample Volume	TDI(mg/M^3)*
	Breathing Zone (Initial Survey - March 22, 23)		
8080	TDI machine operator - No. 3 line	29.0 liters	/ 0.023
8087	" "	25.0 "	/ 0.026
8082	TDI machine operator - No. 3A line	27.5 "	/ 0.025
8089	" "	27.5 "	/ 0.025
8083	TDI machine operator - No. 3B line	25.0 "	/ 0.026
8088	" "	27.5 "	/ 0.025
	General Area (Initial Survey)		
8081	Near finisher packers - No. 3 line	25.0 liters	/ 0.026
8086	" "	27.5 "	/ 0.025
8084	Near finisher packers - No. 3A line	27.5 "	/ 0.025
8085	Near finisher packers - No. 3B line	17.0 "	/ 0.044
8093	Near grinding wheels - No. 3A line	54.0 "	/ 0.014
8094	Near grinding wheels - No. 3B line	55.0 "	/ 0.012
8090	Near horn hub area - No. 3 line	25.0 "	/ 0.026
8091	Near skin placers - No. 3 line	38.5 "	/ 0.020
8092	Control panel - between 3A & 3B lines	46.0 "	/ 0.016
	Breathing Zone (Repeat Survey - July 12)		
8858	TDI machine oper. - No. 2 line (horn hub assembly)	210 liters	/ 0.004
8861	" "	300 "	0.004
8857	TDI machine operator - No. 3A line	200 "	/ 0.004
8862	" "	290 "	/ 0.004
	General Area (Repeat Survey)		
8860	Unloading area near No. 3A line	180 liters	/ 0.004
8863	" "	240 "	/ 0.004
8859	Buffing area near No. 2 line	210 "	/ 0.004
8864	" "	230 "	/ 0.004

*mg/M^3 - approximate milligrams of TDI per cubic meter of air. The symbol (/) means "less than," indicating that TDI was not detected at the detection limit concentration for the volume of air sampled.

Table II. Airborne Concentrations Of Methyl Ethyl Ketone, Toluene, Acetone, and Xylene From Personnel Samples Collected At The Sun Products Corporation Plant, Barberton, Ohio

Sample No.	Operation and Location	Solvent Concentration (ppm)* MEK	TOL.	ACETN.	XYL.
8098	Duck Paint Booth No. 2	/ 10	/ 5	/ 50	---
8099	"	/ 10	/ 5	---	---
8100	Horse Paint Booth	/ 10	/ 5	---	---
8102	Play Ball Decoration	/ 10	/ 5	---	---
8103	"	/ 10	9.0	---	---
8104	Arm Rest Washing Area	210	---	208	---
8105	"	153	---	201	---
8106	Paint Shack Worker	/ 10	/ 5	/ 50	/ 5
8107	"	/ 10	/ 5	/ 50	/ 5
8108	Lacquer Spray Booth (arm rest)	/ 10	/ 5	---	---
8109	"	/ 10	/ 5	---	---

*Parts of vapor per million parts of contaminated air by volume at 25 °C and 760 mm Hg pressure. The symbol (/) means "less than," indicating that the solvent was not detected at the detection limit concentration for the volume of air sampled.

TABLE III. NOISE LEVELS AND C_n/T_n RATIOS FROM SOUND LEVEL MEASUREMENTS TAKEN AT THE SUN PRODUCTS CORPORATION PLANT

LOCATION	SOUND LEVEL(dBA)	C_n/T_n RATIO
Rotational casting machine #1	97 - 100	1.02
Rotational casting machine #2	93 - 105	1.36
Rotational casting machine #3	95 - 105	1.56
Rotational casting machine #4	95 - 105	1.17
Rotational casting machine #13	94	0.23
Furnace No. 17	91 - 100	0.99
Furnace No. 16	90 - 100	0.21

TABLE IV. PERMISSIBLE NOISE EXPOSURES*

DURATION PER DAY, HOURS	SOUND LEVEL(dBA) SLOW RESPONSE
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115 Ceiling Value

* When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fraction: $C_1/T_1 + C_2/T_2 \ldots C_n/T_n$ exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level, and T_n indicates the total time of exposure permitted at that level.