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<p>16. Abstract (Limit: 200 words) On November 17, 1977, a survey team from the National Institute for Occupational Safety and Health (NIOSH) provided technical assistance in evaluating workroom air contaminant levels at Package Machinery Co., East Longmeadow, Mass. The conclusions and recommendations presented in this report are based on environmental measurements, observation of workplace and work practices, medical questionnaires and a review of the current literature.</p> <p>The following process operations and chemicals were investigated: 1) paint spraying, for toluene and methyl-ethyl-ketone (MEK); 2) welding, for total fume, iron oxide, manganese, and chromium; 3) chromeplating, for chromic acid; 4) polishing, for nuisance dust and silica; 5) sand/shot blast for nuisance dust and silica; 6) Teflon coating*, for toluene; and 7) crane cabs, for iron oxides, total particulates and also, carbon monoxide, carbon dioxide, ozone, and nitrogen dioxide via certified gas detection tubes. Airborne concentrations of potential contaminants were obtained in the workers breathing zone and in the general work area. All samples were below the criteria established for this survey. Therefore, based on the analysis of the environmental samples taken and the review of the medical interviews given at the time of survey, it was determined that employees working in the departments investigated at Package Machinery were not being exposed to harmful concentrations on the day of this study. It must be noted, however, that work conditions in the "Welding" Sections and the "Flamecut" section in the new building were reduced below normal due</p>				
<p>17. Document Analysis - a. Descriptors to modifications that were being made on machines.</p> <p>Key words: toluene, methyl-ethyl-ketone, welding, iron oxide, manganese, chromium, painting, sandblasting, carbon dioxide, ozone, nitrogen dioxide, carbon monoxide</p> <p>b. Identifiers/Open-Ended Terms</p> <p>* NIOSH does not endorse trade names or commercial products.</p> <p>c. COSATI Field/Group</p>				
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I. SUMMARY

On November 17, 1977, a survey team from the National Institute for Occupational Safety and Health (NIOSH) provided technical assistance in evaluating workroom air contaminant levels at Package Machinery Company, East Longmeadow, Massachusetts. The conclusions and recommendations presented in this report are based on environmental measurements, observation of workplace and work practices, medical questionnaires and a review of the current literature.

The following process operations and chemicals were investigated: 1) paint spraying - for toluene and methyl ethyl ketone (MEK); 2) welding - for total fume, iron oxide, manganese, and chromium; 3) chromeplating - for chromic acid; 4) polishing - for nuisance dust and silica; 5) sand/shot blast for nuisance dust and silica; 6) Teflon® coating* - for toluene; and 7) crane cabs - for iron oxides, total particulates and also, carbon monoxide, carbon dioxide, ozone, and nitrogen dioxide via certified gas detection tubes. Airborne concentrations of potential contaminants were obtained in the workers breathing zone and in the general work area. All samples were below the criteria established for this survey. Therefore, based on the analysis of the environmental samples taken, and the review of the medical interviews given at the time of survey, it was determined that employees working in the departments investigated at Package Machinery were not being exposed to harmful concentrations on the day of this study. It must be noted, however, that work conditions in the "Welding" sections and the "Flamecut" section in the new building were reduced below normal due to modifications that were being made on machines.

II. INTRODUCTION

The National Institute for Occupational Safety and Health received a request from a representative of Package Machinery in Massachusetts to conduct a general air quality survey of its operations including: welding, paint spraying, chromeplating, polishing/buffing, sand/shot blast, and Teflon® coating. There were not any known medical problems.

*NIOSH does not endorse trade names or commercial products.

III. EVALUATION

A. Process Description - Conditions of Use

Package Machinery Company, East Longmeadow, Massachusetts produces a diversified line of automatic packing machines. These vary from single injection, blow molding machines that produce various forms of bottles, tubes and other items from thermoplastic and rubber materials to specialized types of packaging machines which perform multiple functions, such as automatically weighing, bagging, collating, and case packing the end-product for shipping. Therefore, Package Machinery's production can best be described as a large machining operation which includes numerous smaller operations; e.g., milling, tool and die, paint spraying, welding, chromeplating, polishing, sandblasting, Teflon[®] coating.

There are approximately 400 production employees, 15 maintenance employees, and 275 administrative personnel. During this survey a total of 22 employees were sampled in the various areas investigated, specifically: 1) five welders; 2) two flame cutters; 3) two polishers; 4) one chrome-plater; 5) one sand/shot blast operator; 6) one Teflon[®] coating operator; 7) two crane cab operators 8) one snager operator and 9) two paint sprayers, one per each spray booth. Also, five employees who work in the "Run Off" section of the new building were sampled. These employees work directly across from the spray booth in the new building and were sampled for possible toluene and MEK exposure coming from the paint spraying operation. The following paragraphs describe briefly the different operations investigated at Package Machinery.

The welding operation is performed in the "Weldry" areas which are located in both the Packaging production area and in the new building of the plant. The type of welding varies considerably and requires a number of different welding electrodes and welding wires. All the welding operations investigated were performed under an atmosphere of carbon dioxide, i.e., gas metal arc (MIG) welding. Table I depicts the composition of the electrodes and welding wires used at the time of this survey.

The "Flame Cut" operation, located in the new building, consists of three separate flame cutting areas. Each flame cutting process has a cutting table, approximately 10 feet by 15 feet, which supports the material to be cut. The actual flame cutting apparatus has multiple cutting tips which are attached to a long arm that can be extended across the width of the material to be cut. This apparatus, mounted on two tracks, moves lengthwise while cutting the material. The flame cut operator controls the cutting apparatus at a control panel, located a few feet away from the cutting table.

There are two paint spray booths at the company. One is located in the "Package Production" area of the plant; the majority of painting performed here is for the various multifunctional packaging or food packaging machines that are produced by the company. The second spray booth is located in the new section of the plant; work performed here is for the injection blow molding machinery. The solvents used in both of these spray booths are methyl ethyl ketone and toluene. The paint spray operators are required to wear Willson AR-700 respirators which are NIOSH certified respirators that have a combination organic vapor cartridge and high-efficiency pre-filter. Both operators' respirators needed maintenance, specifically, the inhalation valves and straps.

The polishing operation, located in the "Parts Finishing" area, consists of one belt sander and six polishing/buffing machines. The individual polishing/buffing machine is designed for two wheels per machine. It was noted during the investigation of this area that a number of the polishing/buffing machines had been modified, i.e., additional wheels were placed on a number of the ends of the shafts of these machines presenting a potential health and safety problem. Therefore, in the recommendations section of this report the appropriate measures which should be taken to alleviate these problems has been indicated.

The "Sand/Shotblast" operation is performed in a completely enclosed blast cleaning room. The operator works inside the room to control the blasting operation. The blast cleaning room contains and exhausts the massive amounts of dust which are normally generated during this type of operation. However, a common problem with this type of room is small cracks in the walls and under the large access doors which allow fine dust to escape and contaminate adjacent work areas. Package Machinery eliminated this problem by installing a large curtain that hangs from the ceiling to the floor; during blasting operations the curtain is pulled around the entrance to the chamber, and reduces exposure to the surrounding work areas. Once the material to be blasted has been moved into the room, the operator dons the following protective clothing: gloves, safety shoes, apron, and helmet. The helmet is a "Pangborn Abrasive Blasting Helmet", model number W500 GBA which has filtered air supplied to the hood. An apron is attached to the base of the hood which hangs over the operator's shoulders and thus, prevents foreign matter from entering his eyes, ears, nose, or mouth. The operator draws the curtain, returns to the blasting room, closes the large access doors behind him and begins the blasting operation. The operator usually spends about 30 minutes inside the cleaning room, and normally performs this operation six times a day.

The "Chromeplating" operation is performed by one person in the parts finishing area. Parts to be plated are used for the food packaging machines. A relatively new electroplating tank was operating very efficiently during this survey. The tank has a slot-type exhaust

ventilation system, and was operating at a face velocity of approximately 175-200 linear feet per minute. The chromeplating operation is preceded by a metal cleaning process. A series of cleaning, and rinsing treatments is required in order to prepare the surface of the parts for electrolytic deposition of a particular metal. One problem noted in this area was the improper use of the exhaust dampeners and therefore, recommendations are offered to alleviate this problem.

Two "Overhead Crane" operations, located in the new area of the plant were investigated. Each crane is operated by one person in the suspended cab compartment. The amount and type of materials to be moved by the operator varies considerably, but the operator normally spends between 6 and 7 hours in the cab during the working day.

The final area investigated during the survey was the "Teflon^R Coating" operation. This operation is located in the parts finishing area and the process is normally performed four times a day by one person. The booth (approximately 5 feet wide, 6 feet deep and has a ceiling height of 8 feet) has a permanent work table that enables the operator to place the parts on the table during the spraying operation. A slot-type exhaust hood is located just above the back portion of the table and allows for immediate exhausting of the spray mist. The slot exhaust was operating effectively at a face velocity of approximately 225-250 linear feet per minute which is sufficient for this type of operation.

B. Evaluation Design and Methods

The sampling logistics included personal breathing zone samples, general work area samples and the use of gas detector tubes. The factors evaluated to determine sampling techniques for this survey were the substances being used, the workers' potential exposure to these substances, the duration of exposure, data from previous OSHA surveys, and the existing control measures used at Package Machinery. The sampling and analysis for these substances are discussed below.

Exposure to methyl ethyl ketone and toluene used in the painting operation was determined by collecting personal breathing zone samples on charcoal tubes for approximately 3 to 5 hours depending on the individuals potential exposure. Pumps were used to draw the air sample through the charcoal tubes at either 50 or 200 cc/minute flow rate, depending on the individuals potential exposure from the source. These charcoal samples were analyzed by gas chromatography.

In all of the welding operations airborne concentrations of manganese, iron oxide, chromium, and total fumes were determined by collecting personal breathing zone samples. A pump adjusted to pull a sample volume of 1.5 liters per minute (lpm) was used with 37 mm diameter, 0.8 micrometer pore size Gilman VM-I filters. These filters are encased in

a three piece plastic casset with face caps on and small plugs removed. Sampling for periods representing the entire work shift were run. The filters were clipped to the subjects during the welding operation inside the helmet, and thus, represented that amount of contaminant in the welders helmet or breathing zone concentrations. Metal analysis was accomplished by direct aspiration atomic absorption.

Personal breathing zone samples for hexavalent chromium were collected on 37 mm diameter 5.0 micron polyvinyl chloride (PVC) filters. These filters were also contained in plastic field monitor cassettes with the face caps on and small plugs removed. Pumps sampling at a flow rate of 1.5 lpm, drew the air sample through the filter for approximately two hours. The samples were analyzed by spectrophotometric determination.

The buffing/polishing operators and the sand/shot-blast operators were sampled in a similar manner. Personal breathing zone samples for respirable silica was taken with pumps using 10 mm cyclons at a sampling rate of 1.7 lpm. Total silica (total particulate) samples were taken with a pump and sampled at 1.5 lpm. All samples were collected on FWSB filters and analyzed for quartz and cristobalite via X-ray diffraction. The total particulate filters were contained in plastic field cassettes with face caps on and small plugs removed. Samples for respirable and total particulate for the sand/shot-blast operators were positioned under the apron and just below the operators hood, and therefore, represented that amount of contaminant that was in the operators breathing zone. Crane cab samples for carbon monoxide, carbon dioxide, and nitrogen dioxide were all sampled by NIOSH certified gas detector tubes.

C. Evaluation Criteria

1. Environmental

There are several criteria used to evaluate the potential toxicity of air contaminants of an employee's work environment: (1) NIOSH Criteria Documents for Recommended Occupational Health Standards; (2) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's); and (3) Federal Occupational Health Standards promulgated by the U.S. Department of Labor. The TLV's recommended by the ACGIH are listed below as a reference point for the environmental samples taken. These values are based upon the current state of knowledge concerning toxicity of these substances.

The values for each contaminant are designed to allow an occupational exposure for an 8-hour work day up to a 10-hour work day, 40-hour work week. Time Weighted Average (TWA) over a normal lifetime, without the worker experiencing undue discomfort. In some instances, a few employees

may experience discomfort at or below the criteria. There are some airborne contaminants for which this TWA is inappropriate, consequently, a Ceiling Value for an interval of 15 minutes or less is given. This ceiling concentration should never be exceeded.

The present health criteria has been tabulated below.

<u>Substance</u>	<u>Adopted 8-hour Time Weighted Average (TLV-TWA) (mg/M³*)</u>	<u>Ceiling Value (mg/M³)</u>
Silica		
Free Silica (Respirable) ¹	.05	
Quartz (Total Dust) ²	$\frac{30 \text{ mg/M}^3}{\% \text{ quartz} + 2}$	
Cristobalite ³	$\frac{30 \text{ mg/M}^3}{\% \text{ quartz} + 2/2}$	
Total Particulate ⁴	10	
Toluene "Skin" ⁵	375	560
Methyl Ethyl Ketone ⁶	590	740
Iron Oxide ⁷	5.0	10
Manganese ⁸	5.0"C"	-
Chromic Acid ⁹ & Chromates	.05	-
Carbon Monoxide ¹⁰	35 ppm**	-

*mg/M³ = approximate milligrams of substance per cubic meter of air.

**ppm = parts of substance per million parts air.

"Skin" = Notation refers to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eyes, either by airborne, or more particularly, by direct contact with the substance.

"C" = Ceiling concentrations which should never be exceeded.

¹NIOSH Criteria Document (1974). The OSHA Standard for respirable silica is calculated by dividing 10 mg/M³ by the % quartz + 2.

^{2,3}ACGIH TLV (1977) and the OSHA Standard (1977) both utilize this formula.

⁴ACGIH TLV (1977).

⁵NIOSH Criteria Document (1973). ACGIH TLV (1977).

⁶ACGIH TLV (1977). Current OSHA Standard.

⁷ACGIH TLV (1977). Current OSHA Standard is 10 mg/M³, 8-hour TWA.

⁸ACGIH TLV (1977). Current OSHA Standard.

⁹ACGIH TLV (1977). Current OSHA Standard.

¹⁰NIOSH Criteria Document (1972).

2. Toxicological Effects

Silica

Silica or silicon dioxide when inhaled in its crystalline form can cause a lung disease known as silicosis. Silicosis is a nodular pulmonary (lung) fibrosis which is progressive and debilitating. Onset of this malady may vary from several years to twenty years or more, thus, the symptoms in the initial stages of silicosis are gradual and not pronounced. Symptoms include cough, shortness of breath, wheezes and repeated non-specific chest illness. The percent of free silica present in the environment generally determines the course of the disease. Normally, as the size and number of fibrous nodules in the lungs increases, shortness of breath, rapid breathing and impairment of the oxygen capabilities of the lungs becomes more apparent. Also, it is believed that exposed persons who smoke are more likely to develop silicosis than those who do not. Early silicosis termed "simple silicosis" is normally diagnosed by chest X-ray examination. The reason for determining a workers total and respirable particulate exposure was necessary because the percentage distribution of silica particles is variable between the respirable fraction and the total dust measurement. Of the two forms of crystalline silica of interest in this survey, cristobalite is more fibrogenic than quartz.

Total Particulate (Nuisance Dust)

Nuisance dust has little adverse effects on the lungs and does not produce significant disease if exposures are kept under reasonable control. These dusts are biologically inert in that when inhaled the structure of the alveoli remains intact and little or no scar tissue is formed, and thus any reaction provoked is potentially reversible. Excessive concentration in the work area may decrease visibility, cause eye, ear, and nose discomfort. This can also create injury to the skin due to vigorous cleansing procedures necessary for their removal.

Methyl Ethyl Ketone (MEK)

Primary exposures to MEK are due mainly to inhalation, skin, and eye contact. Skin absorption, while it may occur, is not considered to present a problem. Exposure to vapors of this agent may produce mucous membrane irritation, skin irritation, and dermatitis. More prolonged exposure may result in nausea, vomiting, headache, paresthesia, and narcosis.

Toluene

Toluene has been extensively studied and the major concern is its narcotic effects on workers. Such signs and symptoms as muscular weakness, confusion, impaired coordination, sensitivity to light, repeated headaches, nausea and skin irritation are common effects of overexposure to toluene. Mild fatigue and weakness are normal at or above the TLV.

Iron Oxide

Iron oxide fumes may cause changes in chest X-ray. The collection of particles in the lungs has been termed "Siderosis", a benign condition not leading to a disabling fibrosis. However, the X-ray changes make diagnoses of other disease conditions difficult.

Chromic Acid and Chromates

The biological effects produced by chromic acid are similar to that of other forms of chromium. Chromium compounds have been known to cause ulceration and perforation of the nasal septum and inflammation of the mucous membranes through inhalation. "Chrome holes," which are penetrating sores of the skin, result after contact of hexavalent chromium with the cutaneous layer of skin. Primary sites include the backs of hands, forearms, skin folds over the knuckles, and the nail root areas. Actual primary skin irritation or allergic contact dermatitis is rare in workers using the compound, as opposed to workers producing chromic acid. This is also the case with lung cancer hazards, i.e., the potential for lung cancer is much greater with workers producing chromic acid rather than with those workers working with chromic acid.

Carbon Monoxide

The effects of acute carbon monoxide poisoning are well documented; headaches, nausea, vomiting, dizziness, drowsiness and collapse. However, low level exposure (<100 ppm) effects are not well defined. Behavioral effects such as a reduction in vigilance, visual and audio reduction have been cited in the literature. The effects of exposure is augmented by smoking. There is a well established correlation between smoking and increased risk of coronary heart disease.

IV. RESULTS AND DISCUSSION

The personal breathing zone samples, both the respirable and total results, are presented in Table II. No quartz or cristobalite were detected in any of the samples taken in either the sand/shot-blast area or the polishing/buffing area. These areas were also analyzed for respirable and nuisance dust and these results are also presented in Table II. The measurements were well below the recommended criteria for respirable and nuisance dusts.

Results of personal samples for toluene and methyl ethyl ketone are presented in Table III. The methyl ethyl ketone samples taken for the painters, testers, wiremen, and Teflon[®] coating operators were below the

limits of detection. All but two of the samples taken for toluene on the above persons were also below the limits of detection. The two values above were well within the safe levels for the criteria set for toluene, therefore, these are also considered not to be a problem.

All personal samples for iron oxide, chromium, manganese, and total particulates were below the recommended criteria set for this survey, (Refer to Table IV).

All the personal samples for chromium, which were taken in the electrolytic operation, (Refer to Table V) were below the NIOSH limits of detection.

Carbon Monoxide measurements were taken in both the welding operations and the crane-cab compartments with NIOSH approved detector tubes. Each sample was drawn within inches of the workers face in order to represent the breathing zone. All of these values were within 5-10 ppm which was below the criteria set for this survey.

The non-directed medical questionnaires provided further evidence that there was not a health problem associated with the exposures evaluated during this survey. All the workers stated that they do not have any chronic, or at present, short term health problems which could be related to their job.

Air velocity measurements of the local exhaust systems were taken with an air velocity meter at each hood and compared to the design criteria of the system. Each exhaust system was well within design specifications, except for the following; the Polishing/Buffering system, the system used for the Dipping Tanks, and the Dampers on the Chromeplating exhaust system. In the polishing/buffing area wheels were added to the ends of the shafts, and therefore, extend beyond the original design requirements for these machines. At present the particulate matter normally found with operations like this cannot be exhausted. Also, some exhaust ducts in this area were removed from their original position on the machine and placed on the floor. Figures 1 and 2 are copies of design criteria for buffing/polishing wheels and belt sanders that are recommended by the ACGIH in their Industrial Ventilation Manual.

V. RECOMMENDATIONS

Based on the results received on the substances measured at Package Machinery Company, as well as personal communications with individuals at Package Machinery, the following recommendations should be attended to as soon as possible:

A. Engineering Controls

Whenever possible, engineering controls are the preferred method for decreasing environmental exposures to toxic substances for the protection of the employees' health. Therefore, due to the ventilation problems which presently exist at Package Machinery the following recommendations should be attended to as soon as possible.

1. The Buffing/Polishing Wheels

The wheels that were added to the ends of these shafts must be removed. An alternative would be an exhaust system to adequately control the particulates that are generated by this type of operation. Figure 1 and 2 give specifications on wheel diameters, proper hood dimensions and exhaust volumes which should successfully remove particulates that are associated with this type of process. If this alternative is chosen the existing exhaust system must be fully evaluated in regards to its ability to handle additional hoods, i.e., it may be necessary to increase the size of the fan and/or motor to maintain the required cfm. The engineering firm that installed the original system should be able to advise on any alterations to the system. The exhaust duct placed on the floor should be installed to its original position and evaluated to determine if it is working effectively. Again, the data described in Figure 2 should give sufficient information to determine the effectiveness of this system.

2. Dip Tank

The Dip Tank exhaust system is inadequate in its ability to effectively collect the various contaminants generated. This exhaust system needs maintenance to restore the motor and/or ducting to its original condition or replace this with equipment which will increase the capture velocity of the equipment.

3. Chromeplating

The dampers used on the Chromeplating exhaust system and in the Teflon[®] booth should be operated in a closed position at the end of each working day or when the exhaust systems are not operating on these machines for extended periods of time. This would prevent the down draft of outside air from being drawn back into the exhaust hood, and thus eliminate the dispersion of aerosol solutions which come from these tanks and circulate into surrounding work areas.

B. Personal Protective Equipment

An official written respirator program governing the selection, use of respirators, and maintenance should be established. For those individuals who must wear respiratory protection, education in their proper use and maintenance should be clearly described.

Information on the use, maintenance, and the proper selection of respirators can be found in the NIOSH publication 76-189, "A Guide to Industrial Respiratory Protection". This publication has been sent to management and union personnel. With this information, a respirator program can be designed similar to that described in the OSHA requirements outlined in 29 CFR part 1910.134, and therefore, should assist management in developing an effective respiratory program at Package Machinery.

C. Other Recommendations

1. Because the welding production in the New Building was operating below normal during our investigation at Package Machinery this environment should be re-evaluated. This evaluation should be performed at a time that is indicative of normal operations. Special concern should be given to the Weldry areas, Flamecut area, and the Crane Cab compartments for; total fume, iron oxides, manganese, chromium, carbon monoxide, ozone, and nitrogen dioxide levels. Sampling should be by personal monitoring conducted in a manner similar to that used in this survey.
2. A Material Safety Data Sheet file should be established on all the raw materials being used at Packaging Machine Company. An in-depth procedure on developing such a file can be found in the NIOSH publication, "An Identification System for Occupationally Hazardous Materials." This publication has been sent to the management of Package Machinery Company.

VI. REFERENCES

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Table I
COMPONENTS OF ELECTRODES AND WIRE

Package Machinery Company

E. Longmeadow, Massachusetts

November 17, 1977

<u>Welding Electrodes</u>	<u>Typical Weld Metal Analysis</u>	
AWS A5. 1-76 Class E-7024	Carbon	.04%
	Manganese	.60%
	Silicon	.50%
	Phosphorus	.035
	Sulphur	.035
	Iron	Bulk
AWS A5. 1-76 Class E-6011	Carbon	.10
	Manganese	.45
	Silicon	.20
	Phosphorus	.015
	Sulphur	.035
	Iron	Bulk
AWS A5. 1-76 Class E-7014	Carbon	.09
	Manganese	.46
	Silicon	.32
	Phosphorus	.018
	Sulphur	.022
	Iron	Bulk
AWS A5. 1-76 Class E-7018	Carbon	.06
	Manganese	.65
	Silicon	.37
	Phosphorus	.011
	Sulphur	.013
	Iron	Bulk
<u>Wire</u>		
AWS A5. 20-69 Class E 70T-1	Carbon	.077
	Manganese	1.45
	Silicon	.72
	Phosphorus	.013
	Sulphur	.016
	Iron	Bulk
AWS 20-69 Class E70T-4	Carbon	.15
	Manganese	1.25
	Silicon	.28
	Phosphorus	.010
	Sulphur	.010
	Iron	Bulk

Table II

SUMMARY OF AIR SAMPLING FOR TOTAL PARTICULATES AND FREE CRYSTALLINE SILICA

Package Machinery Company

E. Longmeadow, Massachusetts

November 17, 1977

Job Description	Sample Number	Sampling Time (Min.)	Total Particulate (mg/M ³)	Respirable Particulate (mg/M ³)	Quartz (mg/M ³)	Cristobalite (mg/M ³)	Type of Sample
Sandblast Operator	1	200	7.87	.35	ND	ND	BZ
Polisher	2	200	.16	ND	ND	ND	BZ
Polisher	3	200	4.6	2.26	ND	ND	EZ
Evaluation Criteria			10 mg/M ³	5 mg/M ³	.05mg	Total mg	
NIOSH Limits of Detection			0.01 mg	0.01 mg	0.03 mg	0.03 mg	

mg/M³ = Milligrams of substance per cubic meter of air

BZ = Breathing zone

ND = Non-detectable or below the NIOSH limit of detection

Table III
 SUMMARY OF AIR SAMPLING FOR TOLUENE AND MEK
 Package Machinery Company
 E. Longmeadow, Massachusetts
 November 17, 1977

Job Description	Sample Number	Sampling Time (Min.)	Toluene (mg/M ³)	MEK (mg/M ³)	Type of Sample
Painter (Brush & Spray)	1	330	.07	ND	BZ
Painter (Brush & Spray)	2	330	.08	"	"
Tester	3	230	ND	"	"
Tester	4	230	"	"	"
Tester	5	230	"	"	"
Wireman	6	245	"	"	"
Wireman	7	245	"	"	"
Teflon Coating	8	230	"	"	"
Teflon Coating	9	230	"	"	"

Evaluation Criteria 375 mg/M³ 200 mg/M³

NIOSH Limit of Detection 0.01 mg 0.01 mg

mg/M³ = Milligrams substance per cubic meter of air
 BZ = Breathing zone
 ND = Non-detectable or below the NIOSH limit of detection

Table IV

SUMMARY OF AIR SAMPLING FOR METALS AND TOTAL WELDING PARTICULATE

Package Machinery Company

E. Longmeadow, Massachusetts

November 17, 1977

Job Description	Sample Number	Sampling Time (Min.)	Iron Oxide Fe ₂ O ₃ (mg/M ³)	Chromium Cr ₃ (mg/M ³)	Manganese Mn ₃ (mg/M ³)	Total Particulate (mg/M ³)	Type of Sample
Maintenance Welder	385	345	0.14	ND	0.01	0.50	B ^Z
Arc Welder	386	345	1.05	ND	0.07	2.44	"
Arc Welder	387	345	0.97	0.02	0.07	1.62	"
Flame Cutter	388	240	0.45	ND	ND	0.83	"
Flame Cutter	389	240	0.93	.02	ND	0.70	"
Stick/Mig Welder	390	240	0.55	.03	0.08	3.78	"
Stick Welder	391	240	1.74	ND	0.06	3.00	"
Snager Operator	393	270	3.36	NA	NA	NA	"
Overhead Cab Operator	394	270	0.85	NA	NA	NA	General Area
Overhead Cab Operator	395	270	0.03	NA	NA	NA	General Area

Evaluation Criteria

NIOSH Limits of Detection	5 mg/M ³	.5 mg/M ³	5 mg/M ³	10 mg/M ³
	6 µg	5 µg	3 µg	0.01 mg

mg/M³ = Milligrams of substance per cubic meter of air

B^Z = Breathing zone

ND = Non-detectable

NA = Non-applicable for this operation

Table V
 SUMMARY OF AIR SAMPLING FOR CHROMIUM
 Package Machinery Company
 E. Longmeadow, Massachusetts
 November 17, 1977

<u>Job Description</u>	<u>Sample Number</u>	<u>Sampling Time (Min.)</u>	<u>Chromium (mg/M³)</u>	<u>Type of Sample</u>
Chrome Plater	1	120	ND	BZ
	2	120	ND	BZ

Evaluation Criteria	0.05 mg/M ³
NIOSH Limits of Detection	0.003 mg

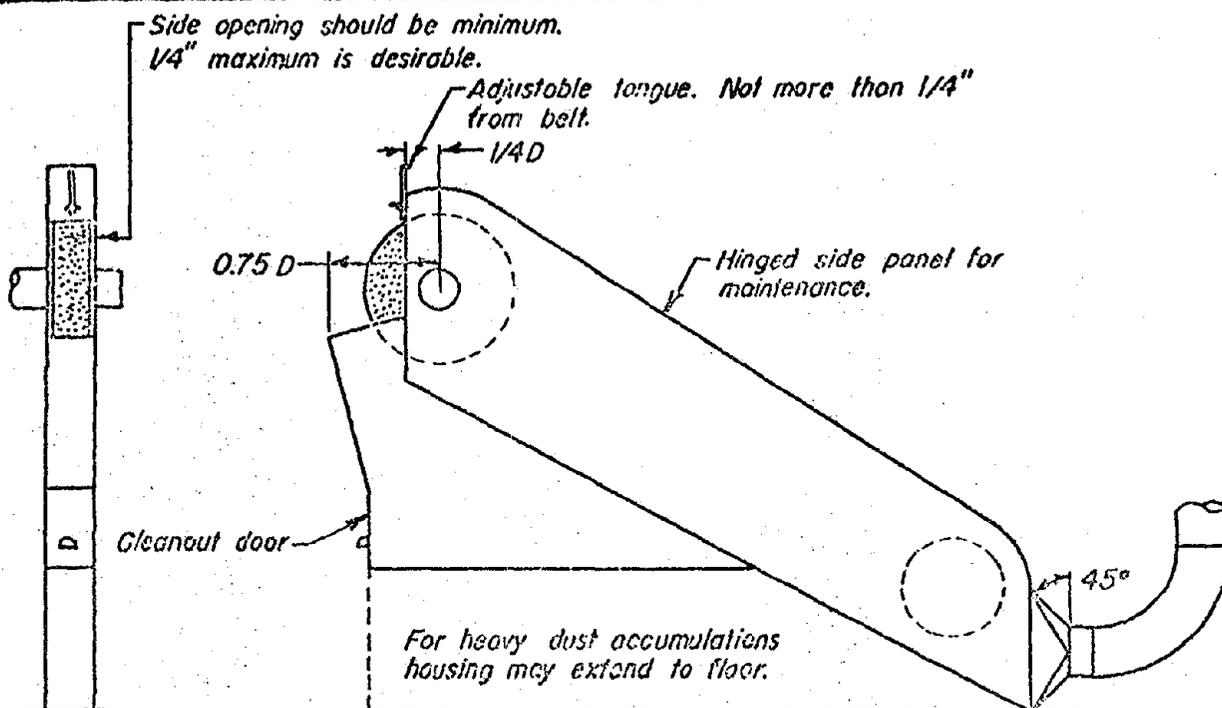
mg/M³ = Milligrams of substance per cubic meter of air
 BZ = Breathing zone
 ND = Non-detectable

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Figure 1

SPECIFIC OPERATIONS

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Belt width inches	Exhaust volume cfm	Exhaust volume cfm
	Good enclosure *	Poor enclosure
1 1/2	220	300
2	390	610
3	590	740
4	610	880
5	880	1200
6	1200	1570

* Hood as shown. No more than 25% of wheel
exposed.

Entry loss = 0.40 VP

Dust velocity = 3500 fpm minimum

Note:

For titanium and magnesium chloride hopper and use
5000 fpm through hood cross section.

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BACKSTAND IDLER POLISHING MACHINE

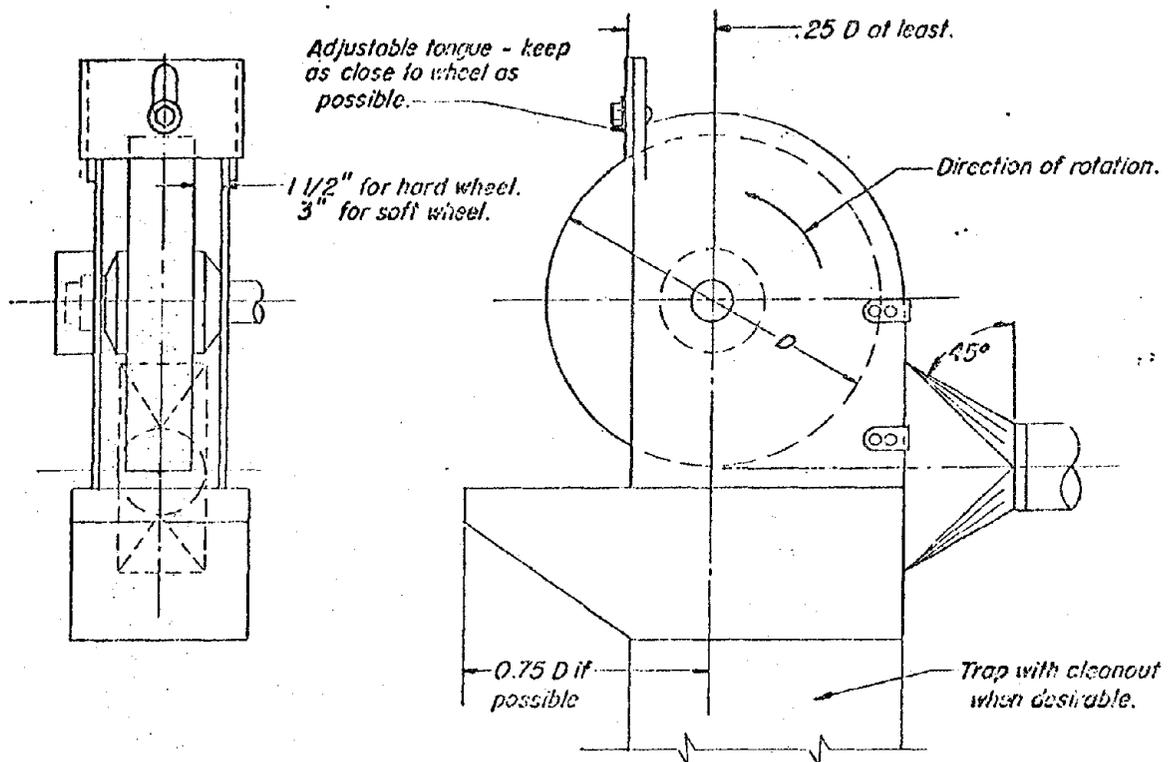
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Figure II
SPECIFIC OPERATIONS

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Minimum duct velocity: 4500 fpm branch.
3500 fpm main.

Entry loss: 0.65 VP for straight take-off.
0.40 VP for tapered take-off.

Wheel diam. inches	Wheel width* inches	Exhaust volume cfm	
		Good enclosure	Poor enclosure
to 9	2	300	400
over 9 to 16	3	500	610
over 16 to 19	4	610	740
over 19 to 24	5	740	1200
over 24 to 30	6	1040	1500
over 30 to 36	6	1200	1990

* In cases of extra wide wheels, use wheel width to determine exhaust volume.

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