U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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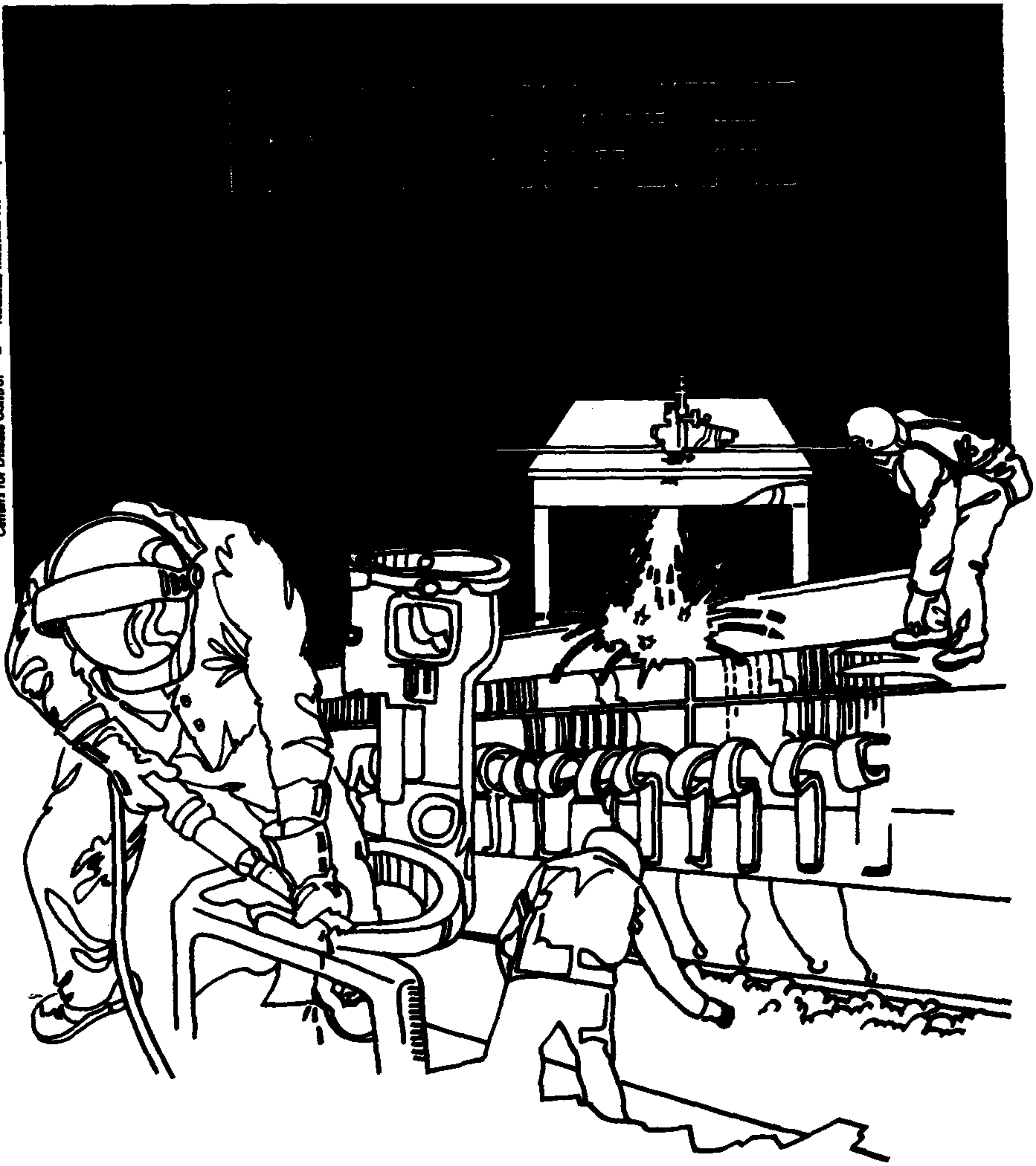

Health Hazard Evaluation Report

HETA 87-353-1899
SAS CIRCUITS, INC.
LITTLETON, COLORADO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 87-353-1899
MAY, 1988
SAS CIRCUITS, INC.
LITTLETON, COLORADO

NIOSH INVESTIGATOR:
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I. SUMMARY

On July 15, 1987, the National Institute for Occupational Safety and Health (NIOSH) was requested by management to evaluate occupational exposures among personnel who were working in the wet processing area, lab, lay-up, deburring, silkscreening, and plate cleaning department at SAS Circuits, Inc., Littleton, Colorado.

In August, 1987, NIOSH investigators conducted an initial visit to this facility. On August 19, and October 1, 1987 and January 8, 1988, NIOSH performed an environmental investigation in all assembly and production areas of the facility. Personal and area samples were collected for freon TF, 1, 1, 1, trichloroethane, methyl isobutyl ketone (MIBK), butyl cellosolve, acetone, chromium, copper, nickel, lead, and cyanide.

Six personal and three area samples were collected on August 19, 1987 and analyzed for freon TF, 1,1,1, trichloroethane, MIBK, and butyl cellosolve. All concentrations were far below the evaluation criteria. Freon concentrations ranged from less than 0.001 mg/M^3 to 34 mg/M^3, 1,1,1, trichloroethane was not detected in any of the samples, MIBK was found in two of the nine samples at concentrations of 1.4 and 6 mg/M^3. Three area and six personal samples were collected on August 19, 1987 for chromium, copper, nickel, and lead analysis. Chromium, nickel, and lead were not detected in any of the samples. Copper was found in trace quantities ranging from 0.001 to 0.23 mg/M^3. On September 30, 1987, copper, nickel, and cyanide samples were collected on seven workers; cyanide and nickel were not found in any of the samples. Copper was found in trace quantities, in two of the air samples (0.04 and 0.01 mg/M^3). On January 8, 1988 the last set of personal and area air samples were collected. These samples were analyzed for Freon TF, Acetone, and MIBK. Three personal and four area samples were collected. Freon TF was not found in any of the samples, Acetone was found in concentrations ranging from 0.7 to 1.7 mg/M^3 and MIBK was found in concentrations ranging from 0.7 to 3.7 mg/M^3. In summarizing the environmental data; a total of 57 organic solvents analyses were performed and in air samples where solvents were detected concentrations were in trace quantities. A total of 56 metal analyses were performed and in samples where metals were detected, concentrations were found in trace quantities. Health hazards were not found during this survey.

Based on information obtained during this survey it was determined that a health hazard from chemical hazards did not exist at the time of this survey. Numerous safety problems were observed and are discussed in the body of this report.

Key Words: SIC 3679 Electronic Components, Circuit Boards, solvents, metals, etching, and electroplating.

II. INTRODUCTION

In August 1987, NIOSH received a request from plant management of SAS Circuits, Inc., Littleton, Colorado to evaluate the wet processing area, laboratory, lay-up, deburring, silk screening, and plate cleaning departments during the routine production of printed circuit boards. In August, October 1987, and January 1988, environmental investigations were performed at this facility. An interim report was given by telephone to the requestor.

III. BACKGROUND

SAS Circuits, Inc., is a new facility which has been in operation approximately four years. SAS has grown from four employees to over 100 in a three year period. This facility specializes in the manufacture of multilayer printed wiring boards. The major processes include: dry film photography, developing, copper etching, resist stripping, epoxy-glass lamination, drilling the boards, copper, lead, nickel, and gold plating, reflowing, silk screening, and solder leveling.

The multiple processes and the ever changing methods of producing circuit boards was the reason that environmental sampling covered such a long time frame. SAS has a safety and health department and asked for NIOSH assistance to assure them that their program was not deficient.

IV. ENVIRONMENTAL DESIGN AND METHODS

All breathing zone and general room air samples for Freon TF (trichlorotrifluoroethane), Acetone, 1,1,1, trichloroethane, butyl cellosolve, and methyl isobutyl ketone (MIBK) were collected on organic vapor charcoal sampling tubes using low flow vacuum pumps (50 to 100 cc/min.) and analyzed using gas chromatography with a flame ionization detector. Ambersorb collection tubes were also used for collection of methyl ethyl ketone (MEK) and MIBK, these samples were analyzed using gas chromatography using a flame ionization detector (splitless mode). All metal samples(Chromium, copper, nickel, and lead) were collected on 37mm AA filters using vacuum pumps operated at 1.5 to 2.0 liters per minute. These filters were analyzed by atomic absorption spectroscopy. Cyanide samples were collected using glass impingers filled with 0.1 normal potassium hydroxide and vacuum pumps operated at 1.0 liters per minute. The cyanide samples were analyzed by visible absorption spectroscopy. The ventilation system was visually inspected both inside the building and on the roof. Ventilation measurements were made using a calibrated velometer. Work practices were observed and employees were informally interviewed.

V. EVALUATION CRITERIA

A. Environmental

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

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

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

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

	Environmental Exposure Limits -Mg/M^3 8-Hour Time-Weighted Average (TWA)	
	NIOSH	OSHA
Freon TF	5600	5600
1,1,1, Trichloroethane	1900	1900
MIBK	205	410
Butyl Cellosolve	LFL	---
Chromium	0.5	0.5
Copper	1.0	1.0
Nickel	0.015	1.0
Lead	0.05	0.05
Cyanide	5.0	5.0
Acetone	1780	2400

B. TOXICOLOGY

(1,1,2-trichloro-1,1,2,-trifluoroethane) Freon TF - The local effects from this freon and most other freons include mild irritation to the respiratory system; dermatitis may occur but is very rare. Central nervous system (CNS) depression may occur from very high exposures. Tremors and incoordination may result from high exposures. Cardiac arrhythmias may also occur. Once removed from exposure, the worker usually recovers immediately.[1]

1,1,1, trichloroethane - is a colorless liquid with a mild odor similar to chloroform. Trichloroethane may enter the body by inhalation of the vapors, ingestion, and absorption through the skin. Exposure to 1,1,1.trichloroethane may cause CNS depression, liver, and heart effects. Human subjects exposed to 900-1000 ppm for 20 minutes have experienced lightheadedness, uncoordination, impaired equilibrium and transient eye irritation. A few scattered reports have indicated mild kidney and liver injury from severe exposure. Skin irritation has occurred from occupational contact. A number of human fatalities related to industrial exposure in closed spaces have been reported. 20,000 ppm for 60 minutes is expected to produce coma and possible death.[2]

NIOSH is currently recommending an action level of 200 ppm for classifying "inhalation exposure" to 1,1,1,trichloroethane. When in excess of this level, personnel should be warned of possible congenital abnormalities.[3] In Current Intelligence Bulletin #27, NIOSH has suggested that 1,1,1,trichloroethane be treated in the workplace with caution because of its chemical similarity to four other chloroethanes shown to be carcinogenic in laboratory animals.

Methyl Isobutyl Ketone (MIBK) - is an irritant of the eyes, mucous membranes, and skin; high concentrations cause narcosis in animals, and it is expected that severe exposure will cause the same effect in humans.

In humans, 400 ppm may be expected to quite objectionable and cause irritation of the eyes and nose; 200 ppm is irritating to the eyes. Workers exposed to approximately 100 ppm may complain of nausea and headache, but eventually develop a tolerance, usually in about one week.[4] Prolonged skin exposure may cause defatting of the skin which could lead to dermatitis. The exposure limit was set to prevent eye irritation.

Butyl Cellosolve - is an irritant of the eyes and mucous membranes; in animals it is a hemolytic agent, and severe exposure in humans is suspected to produce the same effect. Due to similar chemical structure with butyl cellosolve, it is suspected of causing reproduction toxicity which is associated with other glycol ethers.

Human subjects inhaling 195 ppm for eight hours had discomfort of the eyes, nose, and throat. There were no signs of injury and no increase in erythrocytic fragility. The liquid penetrates the skin readily. Liquid splashed into the eye can produce marked pain and appreciable irritation.[4]

Acetone - has been considered to be a low hazard to health, since few adverse effects have been reported, despite widespread use for many years. Awareness of mild eye irritation occurring at airborne concentrations of about 1000 ppm. Very high concentrations (12,000 ppm) depress the central nervous system, causing headache, drowsiness, weakness, and nausea. Repeated direct skin contact with the liquid may cause redness and dryness of the skin.[5] However, at least 6 studies have been reported in the literature which have documented possible adverse effects in humans at exposures below 1000 ppm. The available evidence indicates that occupational exposure to acetone may lead to its accumulation in the body. NIOSH has recommended lowering the current exposure limit from 1000 to 250 ppm.[6]

Chromium - the most toxic route of entry is by inhalation, followed by percutaneous. Chrome (metal) is very corrosive and is a strong sensitizer. Perforation of the nasal septum is seen frequently. The Occupational Safety and Health Administration (OSHA) Permissible exposure limit (PEL) for chromic acid and chromates is 0.1 mg $CrO3/M^3$ (ceiling); for soluble chromic and chromous salts, 0.5 mg Cr/M^3 (8-hour time weighted average (TWA); and for chromium metal and insoluble salts, 1mg Cr/M3 (8-hour TWA).

NIOSH recommends for a 10-hour TWA for carcinognic hexavalent chromium is 1 ug Cr (V1)/M^3; for noncarcinogenic Cr(V1) compounds which include chromic acid the NIOSH recommended exposure level is 25 ugCr(V1)/M^3 (10-hour TWA) and 50 ug Cr(V1)/M^3 (15 minute ceiling). The compounds used in this facility were of the non carcinogenic variety, such as chromic acid.

Copper - Chronic exposure to chromium dust and mist may cause irritation of the mucous membranes, pharynx, nasal septum perforation, eye irritation, a metallic taste and dermatitis. The PEL was not exceeded in any of the air samples taken during this survey.

Nickel - Nickel exposures may lead to some similar metabolic changes that occur from copper exposures, such as; nasal lesions and cavities, lung irritation that may lead to a pneumonitis. Lung and nasal cancer have long known to be caused by nickel and nickel carbonyl. Nickel was not an environmental hazard during this evaluation.

Lead - Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead interferes with red blood cell production and may affect the kidneys, peripheral and central nervous systems, the flood forming organs (bone marrow), and the reproductive system.

Blood lead levels below 25 micrograms/deciliter (ug/dl) whole blood are considered to be levels which may result from daily environmental exposure. Individual PbB's between 25-40 ug/dl are in excess of the national averages, but are not associated with readily identifiable signs or symptoms. Lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive adsorption of lead and may result in more readily clinically identifiable adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations which may cause serious adverse health effects. Blood lead levels over 100 ug/dl are considered to be extremely dangerous and often these workers require hospitalization and medical treatment.

The OSHA standard for lead in air is 50 ug/M^3 calculated as an 8-hour time weighted average for daily exposure. According to the standard, blood lead and protoporphyrin levels must be monitored at least every 6 months for workers exposed to air lead levels above 30 ug/M^3 for more than 30 days per year, and at least every 2 months if the worker's last lead was at or exceeded 40 ug/100 g whole blood. The standard also dictates that workers with blood lead levels greater than 60 ug/100 g whole blood must be immediately removed from further lead exposure if these levels are confirmed by a follow-up test. Workers with average lead levels of 50 ug/100 g or greater must be removed. Removed workers have protection for wage, benefits, and seniority for up to 18 months or until they can safely return to lead exposure areas.

Cyanide - Cyanide exposure above 5 mg/M^3 can lead to asphyxia and death. Cyanide is toxic by all three routes of entry, lungs, skin, and ingestion. The most important thing to remember in a factory such as the one in this evaluation is to keep the cyanide and acids removed from each other so that HCN is not produced. Target organs for cyanide include the cardiovascular and central nervous systems, liver, kidneys and skin.

VII. ENVIRONMENTAL RESULTS AND DISCUSSION

The results of all environmental sampling are presented in tables 1 thru 5. As evidenced from these data, no overexposures were found during this evaluation.

Breathing zone and general room air samples were collected in all areas of this facility which were; wet processing, lab, lay up, deburring, silkscreening, and plate making departments.

A total of 9 personnal and 7 area samples were collected and 57 analyses were performed for Freon TF, Acetone, MIBK, 1,1,1, trichloroethane, and butyl cellosolve. 1,1,1, trichloroethane was not found in any of the samples. Freon TF was found in 5 of 16 samples in trace quantities ranging from 2mg/M^3 to 34 mg/M^3. MIBK was found in 9 of 16 samples in concentrations ranging from 0.7 mg/M^3 to 6.0 mg/M^3, Butyl Cellosolve was found in 3 of 9 samples levels were 2 mg/M^3, 2 mg/M^3 and 1.6 mg/M^3. Acetone was found in 7 of 7 samples at concentrations ranging from 0.7 mg/M^3 to 1.7 mg/M^3. Six breathing zone and three general room air samples were collected and analyzed for chromium, copper, nickel, and lead. Chromium, nickel and lead were not found in any of the samples. Copper was found in trace quantities in all nine samples; levels of copper ranged from 0.001 to 0.23 mg/M^3. Three additional breathing zone samples were collected for copper and nickel at a different plating station on a different date, nickel was not found in the samples and copper was found in two of the samples in concentrations of 0.04 and 0.01 mg/M^3. Four Cyanide general room air samples were collected in the gold plating and stripping area. Cyanide was found in all four samples in concentrations of 0.0004 mg/M^3.

Several safety hazards were documented during this survey. The most important safety hazard that should be addressed immediately is the addition of an eye wash station in the plating department. This eyewash fountian should be the type that is hooked up to the potable water supply and not the small jar with a quart of eye wash solution. When an acid or base solution gets into the eyes they should be washed at an eye wash station for a minimum of 15 minutes. Rubber gloves and high top rubber boots should be worn in the plating department. Goggles and full face protection should be worn when adding acids and plating solutions to the plating and etching tanks.

Ventilation measurements of all plating and etching tanks showed capture velocities ranging from 500 to 1000 feet per minute. This is sufficient to prevent room air being contaminated with acids and metals. The roof top fans and exhaust stacks were in excellent condition and were apparently operating satisfactory.

VIII. RECOMMENDATIONS

1. Employees should be educated on the toxicology of all chemicals that they are using at their workplace.

2. When new chemicals are added to the process their toxicology should be explained to all workers in that department.

3. Eye wash stations with sufficient water available to wash eyes for at least 15 minutes should be installed in the plating and etching departments.

4. The large water hose that is distributed on the floor to all parts of the plating department should be replaced with several hoses of shorter length that can be stored when not being used. This would eliminate the tripping hazard, and the physical stress of dragging the hose over this department.

5. A designated and compatable storage area for all the acids, etching, and plating chemicals should be done immediately.

6. A chemical hood with exhaust fans should be installed in the laboratory. Sufficient fresh make up air should be introduced into the laboratory so that the exhaust fans will operate properly and to prevent a negative pressure in the laboratory. A negative pressure would draw chemicals into the laboratory that might interefere with the chemical analyses.

IX. REFERENCES

1. Occupational Disease "A Guide to Their Recognition" June 1977, DHEW, NIOSH, USPHS. Pages 204-205

2. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Washington, D.C.: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) Publication No. 81-123.

3. NIOSH Current Intelligence Bulletin #27, Chloroethanes: Review of Toxicity, DHEW No. 78-181, August 1978.

4. Proctor, N.H., J.P. Hughes, "Chemical Hazards of the Workplace" J.P. Lippincott Co., New York, 1978. pgs. 347 - 348 and pgs. 135 - 136.

5. Proctor, N.H., J.P. Hughes, "Chemical Hazards of the Workplace" J.P. Lippincott Co., New York, 1978. pgs. 488 - 489.

6. Criteria for a Recommended Standard, Occupational Exposure to Ketone. DHEW (NIOSH) Publication No. 78-173, Cincinnati, Ohio: NIOSH; 1978.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. SAS Cirsuits, Littleton, Colorado
2. U.S. Dept. of Labor/OSHA, Region VIII
3. NIOSH - Denver Rrgion
4. Colorado Department of Health

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

Table I

Breathing Zone and General Room Air Concentrations of
Freon TF, I,I,I, Trichloroethane, MIBK, and Butyl Cellosolve
at SAS Circuits
in Littleton, Colorado
on August 19, 1987

Sample #	Job Title	Sampling Time	FrTF	Mg/M^3 III,	MIBK	BUC
01	Lay up/lamination	7:00a - 10:25a	34	*	*	1.6
02	Screening/screening	7:15a - 12:07p	*	*	*	*
03	General area/screening	7:15a - 11:40a	*	*	1.4	*
04	Dry Film/Dry Film	7:45a - 11:55a	13	*	*	2
05	General Room/Dry Film	7:45a - 11:35a	19	*	*	2
06	General Room/Dry Film	11:40a - 2:50p	4	*	*	*
07	Silk Screening/screening	11:40a - 2:50p	2	*	6	*
08	Dry Film/Dry Film	12:40p - 3:00p	*	*	*	*
09	Silk Screening/screening	12:40p - 2:30p	*	*	*	*
Evaluation Criteria			5600	1900	205	LFL
Laboratory Limit of Detection Mg/tube			0.07	0.08	0.04	0.07

FrTF = Freon TF
III, = I,I,I, Trichloroethane
MIBK = MIBK
BUC = Butyl Cellosolve
LFL = Lowest Feasible Limit

Table II

Breathing Zone and General Room Air Concentrations of
Chromium, Copper, Nickel and Lead
at SAS Circuits
in Littleton, Colorado
on August 19, 1987

				Mg/M^3		
Sample #	Job Title	Sampling Time	Chrm	Copr	Nicl	Led
101	General Room/Plating	6:50a - 3:05p	*	0.008	*	*
102	General Room/Plating	6:55a - 3:00p	*	0.006	*	*
103	General Room/Plating	7:00a - 3:07p	*	0.004	*	*
104	Plater/Plating	7:25a - 1:30p	*	0.02	*	*
105	Supervisor/Plating	7:25a - 1:30p	*	0.008	*	*
106	Plater/Plating	7:25a - 3:10p	*	0.01	*	*
107	Plater/Plating	7:35a - 12:40p	*	0.01	*	*
108	Chemist/Lab	7:35a - 3:11p	*	0.001	*	*
109	Buffer/Copper Buffing	8:25a - 9:00a	*	0.23	*	*
Evaluation Criteria			0.5	1.0	0.015	0.05
Laboratory Limit of Detection Mg/Filter			0.001	0.001	0.001	0.002

Chrm = Chromium
Copr = Copper
Nicl = Nickel
Led = Lead

Table III

Breathing Zone and General Room Air Concentrations of
Copper and Nickel
at SAS Circuits
in Littleton, Colorado
on September 30, 1987

			Mg/M^3	
Sample #	Job Title	Sampling Time	Copper	Nickel
200	Plating	7:30a - 11:10a	**	*
201	Plating	7:30a - 1:00p	0.04	*
A-1	Plating (Plater)	7:20a - 1:00p	0.01	*
Evaluation Criteria			1.0	0.015
Laboratory Limit of Detection			0.0003	0.0009

** = at Detection Limit of 0.0003 Mg/Filter
* = Below Detection Limit of 0.0003 Mg/Filter

Table IV

General Room Air Concentrations of
Cyanide
at SAS Circuits
in Littleton, Colorado
on September 30, 1987

Sample #	Job Title	Sampling Time	Mg/M³ Cyanide
CN-1	Gold Plating	7:00a - 11:10a	0.0004
CN-2	Gold Plating	7:00a - 11:10a	0.0004
CN-10	Gold Plating	7:00a - 11:10a	0.0004
CN-20	Gold Plating	7:00a - 11:10a	0.0004
Evaluation Criteria			5.0

Laboratory Limit of Detetion 0.07 ug/Filter

Table V

Breathing Zone and General Room Air Concentrations of
Freon TF, Acetone, and Methyl Isobutyl Ketone (MIBK)
at SAS Circuits
in Littleton, Colorado
on January 8, 1987

Sample #	Job/Location	Sampling Time	FrTF	Mg/M^3 ACTN	MIBK
100	Silk Screening	7:07 - 10:35	*	1.3	1.3
101	Area/Cleaning Screen	7:10 - 10:40	*	1.4	2.1
102	Area/Cleaning Screen	7:10 - 2:00	*	1.7	1.3
103	Silk Screening	7:12 - 2:00	*	1.7	0.7
104	Area/Silk Screen	7:15 - 10:40	*	1.3	2.8
105	Silk Screening	10:40 - 2:00	*	1.3	3.7
106	Area/Silk Screening	10:40 - 2:30	*	0.7	1.2
Evaluation Criteria			5600	1780	205
Laboratory Limit of Detection			0.01	0.02	0.02
Laboratory Limit of Quantitation			0.03	0.05	0.05