

Walk-Through Survey Report

Western Electric Company  
Atlanta Service Center  
Atlanta, Georgia

SURVEY CONDUCTED BY:  
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DATES OF SURVEY:  
May 4, 1982

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Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Surveillance, Hazard Evaluations and Field Studies  
Industrywide Studies Branch  
Industrial Hygiene Section

PURPOSE OF SURVEY:

This walk-through survey was conducted as part of a series of such visits by the Industrywide Studies Branch in an effort to locate a suitable cohort for studies of the potential health effects of glycol ethers.

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STANDARD INDUSTRIAL  
CLASSIFICATION:

3661

## Introduction

The Industrywide Studies Branch (IWSB) of the National Institute for Occupational Safety and Health (NIOSH), Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS), initiated in 1982 an investigation of possible reproductive health effects in workers resulting from exposure to a class of organic solvents known generically as glycol ethers.

This walkthrough survey at the Western Electric Company, Atlanta Service Center, Atlanta, Georgia, was one of a series of such surveys conducted in a variety of industries. These surveys were conducted to locate a population of workers exposed to one or more glycol ethers which would be suitable for an epidemiologic study of reproductive function.

## Description of Facility and Process

The Western Electric Company, Atlanta Service Facility consisted of a two story building covering approximately two acres (200,000 square feet of floor space) plus an adjoining single story warehouse. The plant was constructed in 1975.

The facility was primarily engaged in the repair and/or reconditioning of tele-communications equipment, including dismantling, cleaning, repair or replacement of components, re-assembly, and testing for proper operation. Most of the work consisted of benchwork by individual workers. The shop floor space was divided into sections in which specific types of equipment were serviced. For example, sections were devoted to Touchtone<sup>R</sup> dials, handset assembly, and Com-key<sup>R</sup>, data set, pay phone, and teletype repair, to name just a few. Ten conveyORIZED line operations (six to eight of which are in use at one time) were also used for repair and cleaning of higher volume items, such as standard telephone desk sets.

At each of the repair areas, or at the individual stations on the conveyORIZED lines, a variety of assembly/disassembly or repair operations were performed including soldering, cleaning with solvents, replacement of electronic parts, testing (using a variety of electronic test instruments) and general electronic repair. Line operations tended to be more standardized in that each worker performed a more or less repetitive repair or assembly task.

The shop area also included a semi-automated telephone housings/handset and cap cleaning and painting area. In this area, old telephone housings were collected, placed on a conveyor, sent through a caustic water/detergent wash system, manually placed on a chain conveyor, and conveyed through two paint booths, one for housings and handsets and one for caps. In these booths, a coat of polyurethane paint was applied by automated reciprocating paint spray guns. The parts exiting the booth were conveyed to an upper level where they passed through a curing oven. Parts exiting the oven were visually inspected, individually or bulk packed as required. Since the booths were semi-automated, only one or two booth attendants were required to observe and operate the paint system.

The operation of interest at this facility was the manual hand cleaning of various telephone parts using a technical grade of 2-ethoxyethanol (ethylene glycol monoethyl ether), and the consequent potential for exposure of workers via inhalation or skin absorption.

According to plant officials, approximately 150 of the 300 shop workers intermittently used small amount of 2-ethoxyethanol to clean small parts, e.g., to clean dirt from cords, to remove ink stampings from small electronic parts, and to clean small moving parts (dials, key pads etc.). The 2-ethoxyethanol (2-EE) usually was supplied to the work stations in small metal cans in sizes from 4 oz. to 14 oz. The containers were labeled KS-8446 solvent, which according to the material safety data sheet, was essentially 100% 2-EE.

At each work station, the individual worker typically used from 4 ounces per month to 4 ounces per week, depending on the type of operation and equipment being repaired, as well as the preferences of the worker. The solvent was used by dampening a disposable tissue or shop rag with the solvent which was then used to wipe the surface to be cleaned. No local ventilation or personal protective equipment was routinely used at each work station, although general dilution ventilation was provided. Rubber gloves were available to any worker who requested them, although gloves were not routinely used during the survey.

#### Description of Workforce and Personnel Records

The Atlanta Service Center employed approximately 575-600 persons, of whom approximately 325 were production employees. Of these, plant officials estimated that approximately half (150) at least occasionally used the KS-8446 (2-EE) solvent at their work station for cleaning, removal of ink markings, etc. Approximately 90% of the production workers were employed on the first (7:15 a.m. - 3:45 p.m.). The remainder worked the second shift (4:15 p.m. - 12:15 a.m.). About one third of the production workforce was female.

Personnel records were maintained in hard copy on terminated employees for approximately three years. All records went back eight years (to the startup date for the facility). The 1350 records available in hard copy listed general job titles (but not specific job or task), name, social security number, and date of birth. Records had been computerized and were available for the last two years on current and terminated employees. The union (Local 3295 of the CWA) also maintained membership records in hard copy which were kept for about three years. These records were purged every three or four months and do not contain a work history.

#### Description of Industrial Hygiene, Safety, and Medical Programs

On-site industrial hygiene functions are implemented from the Western Electric Company Southwest Regional Service Center, Baldwin, Missouri. Safety program functions are implemented on site by the Safety Manager at

the Atlanta Service Center. Personal protective equipment required for workers included safety glasses, safety shoes, and respirators in the spray painting area. There was no formal respirator fitting program in effect, nor was there a program in effect for systematic cleaning or repair/replacement of respirators. There was a separate cafeteria for lunches, breaks, etc. The plant has prepared a written safety program document, which is updated annually.

One physician was assigned to the Atlanta Service Center from the Southwest Regional Center for two days per week. The plant also employed one full time nurse who worked the first shift only. The plant had an agreement with a local hospital (approximately 15 minutes from the plant) for emergency care. Pre-employment physical examinations were given to all employees upon starting work. Depending on the job assignment, these include chest x-rays, hearing tests, visual exam, lung function, CBC, SMA-20, routine urinalysis, and EKG.

#### Description of Past Exposures

No environmental monitoring data were available at this plant documenting exposure of repair station workers to 2-ethoxyethanol (KS-8446), either currently or in the past. An industrial hygiene survey was conducted in March, 1982 focusing on the spray painting operation. The results of the sampling at that time indicated exposures of painters to 2-methoxyethanol and 2-ethoxyethyl acetate (present in the paints) were very low (generally less than 1 ppm) relative to the appropriate OSHA standards or Threshold Limit Values.<sup>5</sup> However, these exposures related only to a very limited number of employees classified as painters, and not to the general shop workers.

#### Inspection of Plant and Hazard Analysis

A walk-around tour of the shop areas indicated that very little, if any local ventilation was used at the individual repair stations. However, the air conditioning system for the shop area provides general dilution at the rate of approximately 28,000 CFM in the summer or winter (18% makeup air, one air change every 48 minutes), or 160,000 CFM in the spring or fall (100% makeup air, or one air change every 9 minutes). The use of gloves or other personal protective equipment (other than the usual safety glasses and shoes) was minimal, although any of these items were available on request.

Observations of repair operations at eleven separate stations in the shop indicated moderate, occasional use of the 2-ethoxyethanol (KS-8446) solvent. Individual workers indicated they used it to clean equipment or parts from 4 to 20 times per day and used a total of from four ounces per week to four ounces per month. Each use involved wetting a rag or tissue with a few drops, and then using it to wipe the equipment. Since the workers typically did this bare-handed, exposure was possible through skin absorption as well as inhalation of the vapor. In addition to the KS-8446 solvent, a small number of workers used mineral spirits or a petroleum distillate blend as a solvent, although this use was minimal compared to

the use of the 2-ethoxyethanol. Additional potential exposures observed included solder fumes at the repair stations, and hexamethylene diisocyanate (HMDI), toluene diisocyanate (TDI), chromate (expressed as CrO<sub>3</sub>), and various solvents (e.g., 2-methoxyethanol, 2-ethoxyethyl acetate, toluene, xylene, and others) at the spray paint operation.

Animal studies of glycol ethers and their derivatives have indicated that certain of the glycol ether compounds have a variety of reproductive effects, including fetotoxic and teratogenic effects in pregnant females and testicular atrophy and infertility in males.<sup>1-4</sup> Particularly implicated in these studies were ethylene glycol monomethyl ether (2-methoxyethanol), ethylene glycol monoethyl ether (2-ethoxyethanol or 2-EE), and their acetate derivatives.

In May, 1983, NIOSH published a Current Intelligence Bulletin #39<sup>7</sup>, detailing recent findings regarding several glycol ethers, and recommending that 2-EE be treated in the workplace as having the potential to cause adverse reproductive effects in male and female workers, based on effects seen in animals.

OSHA's Permissible Exposure Limit for occupational exposure to 2-EE is currently 200 ppm (740 mg/m<sup>3</sup>), calculated as an eight hour, time weighted, average concentration. It should be noted that this standard was adopted by OSHA in the early 1970's, and was based on existing studies indicating blood, liver, kidney, and central nervous system toxicity. The standard does not address the reproductive effects seen recently in animals at or below the OSHA PEL.

The 1983-84 Chemical Substances TLV Committee of the American Conference of Governmental Industrial Hygienists also recommended a Threshold Limit Value (TLV) of 50 ppm for an eight hour, time weighted, average exposure, and a Short Term Exposure Limit (STEL) of 100 ppm. The TLV may be reduced in the future to 5 ppm.<sup>5</sup> Both the OSHA PEL and the TLV carry a "skin" notation, indicating that 2-EE is rapidly absorbed through the skin.

#### Methods

In an effort to quantitate in a general way the level of exposure workers to 2-ethoxyethanol, four personal breathing zone air samples were obtained during the survey, as well as samples of blood serum from the same employees.

In brief, the air samples were obtained using 150 mg SKC<sup>TM</sup> charcoal tubes in conjunction with MDA Accuhaler<sup>TM</sup> low volume sampling pumps fitted with 50 cc/min. limiting orifices. Total sample volume was approximately 15 liters. The tubes were attached to the workers' collars and the pumps to their belts. Analysis of the tubes for 2-ethoxyethanol was done by gas chromatography using NIOSH Method S-361.<sup>6</sup>

Blood samples were drawn in the afternoon near the end of the shift so that the analytical results would reflect that shift's exposure. The samples

were obtained using lavender stoppered Vacutainers<sup>TM</sup> containing Sodium EDTA. Subsequently, blood was analyzed by salting out the 2-ethoxyethanol from the blood matrix into carbon disulfide using sodium sulfate. Quantitation was done using capillary column gas chromatography and flame ionization detection.

#### Environmental and Biological Sampling Results

Table 1 presents the results of the air and blood samples obtained during the survey. As indicated, the personal breathing zone concentrations of 2-ethoxyethanol ranged from 0.18 to 0.58 ppm. These concentrations are far below the 1983-84 ACGIH Threshold Limit value of 50 ppm, or the proposed TLV of 5 ppm.

The results of analysis of the blood samples obtained from these same employees (Table 1) indicated all values were below the limit of detection (5 ug/ml). Since the method used was experimental, it is not known for certain that these results accurately reflect exposure or total absorption.

#### Conclusions and Recommendations

The exposures of most employees to 2-ethoxyethanol at this plant, as indicated by limited air sampling results, were very low. It is possible that during the summer and winter (when makeup air is limited to 18% of total circulated air), exposures may be somewhat higher than during the spring or fall (this survey was conducted in May). However, this difference is not likely to result in exposures approaching the current TLV of 50 ppm, the most stringent recommended standard at present.

Currently available biomonitoring techniques may not be adequate to assess total biologic absorption. The nondetectable results seen in this survey may reflect low absorption or a defect in the analysis, although due care was used in analyzing the blood samples. Additional development work would be desirable to assure accurate results in the future, and to better determine the relationship between absorption, exposure, and appropriate biochemical measures of exposure.

The toxicity of 2-ethoxyethanol at the levels of exposure found in this survey are not known. However, for the purpose of conducting a reproductive toxicity study, NIOSH should attempt to locate other cohorts with higher exposure.

## References

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6. NIOSH Manual of Analytical Methods. Volume 5. National Institute for Occupational Safety and Health, Cincinnati, Ohio. 1979.
7. Current Intelligence Bulletin 39. Glycol Ethers: 2-Methoxyethanol and 2-Ethoxyethanol. National Institute for Occupational Safety and Health. May, 1983.
8. Occupational Safety and Health Standards. Subpart Z. Toxic and Hazardous Substances. 40FR23072, Section 1910.1000. 1975.

TABLE 1

Personal Sampling Results  
2-Ethoxyethanol in Air and Blood  
Sampling Date: 5/4/82

Job/Area	Sample No.	Time Start	Time Stop	Concentration	
				Air (ppm)	Blood (ug/ml)
Employee A- Pay Telephone Repair	WE-06	1019	1523	0.18	<5
Employee B- Line 1, Telephone Set Repair	WE-01	1058	1532	0.20	<5
Employee C- Code-A-Phone Repair	WE-05	0932	1526	0.58	<5
Employee D- General Keyset Repair	WE-04	1030	1530	0.23	<5