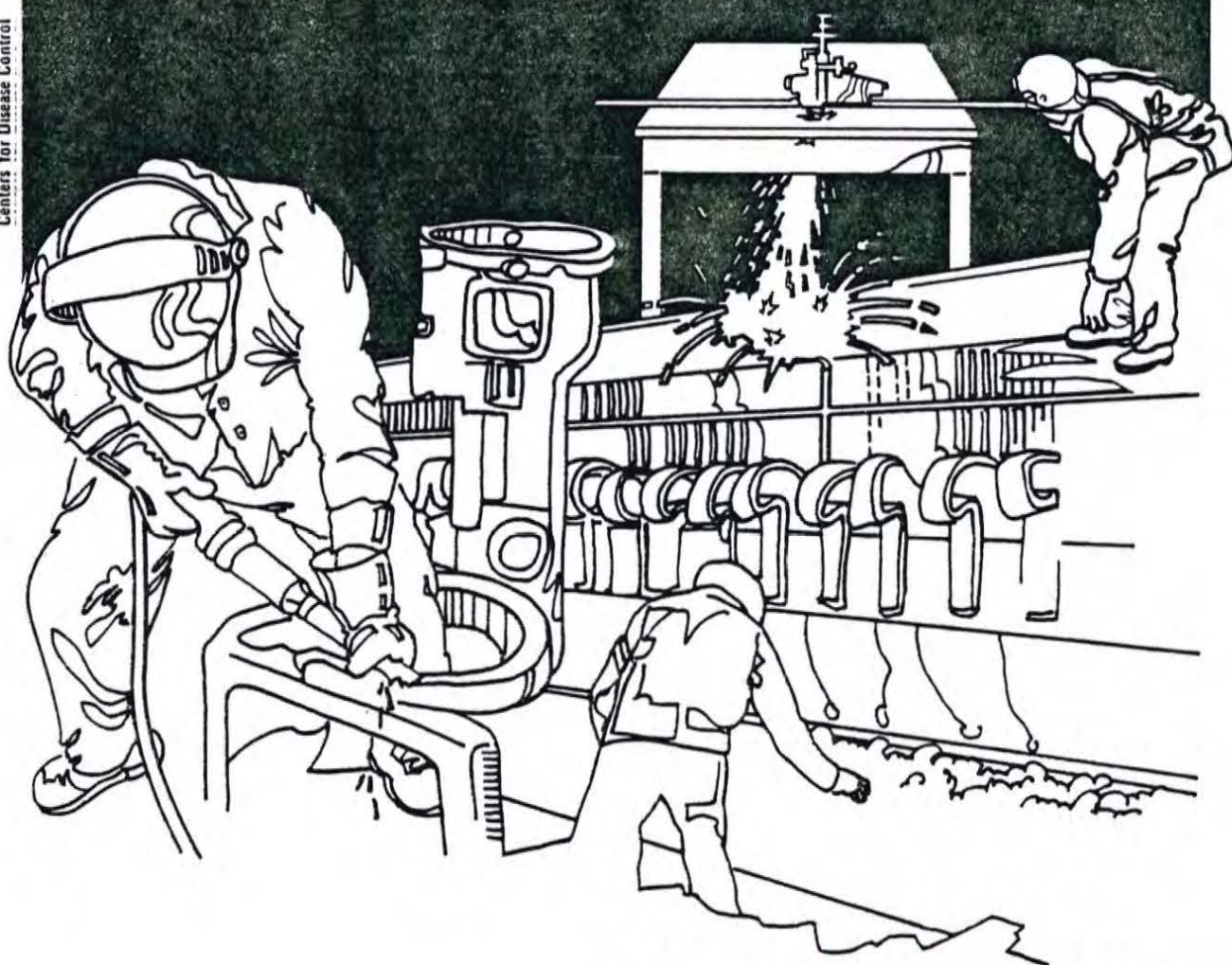


NIOSH



Health Hazard Evaluation Report

80-219-775

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. 699(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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HE 80-219-775
NOVEMBER 1980
CAREFREE OF COLORADO
BROOMFIELD, COLORADO

NIOSH INVESTIGATORS:
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I. SUMMARY

On July 31, 1980, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation at the request of Carefree of Colorado in Broomfield, Colorado, to determine the intensity of the electromagnetic fields emitted by three radio frequency (RF) plastic sealers.

The three sealers are not enclosed, and very little shielding was provided to the operator. A comprehensive RF survey was performed and field strengths were recorded for sites producing detectable levels of radiation. For the three systems surveyed, electric field strength measurements ranged from 1296 to 416025 volts²/meter² (V²/m²); magnetic field strengths ranged from non-detectable (ND) to 0.0036 amperes²/meter² (A²/m²). All measurements were taken at or very close to the operator under normal operating conditions. Current OSHA standards based upon "thermal effects" of RF radiation limit exposures to 10 milliwatts/square centimeter, equivalent in the far field to 40,000 V²/m² - E field and 0.25 A²/m² - H field.

The only medical effects found were thermal burns. These burns were not from RF directly, but from the static charge on machinery due to the RF and electrical fields during normal operation.

On the basis of these measurements, NIOSH determined that the operators of those systems surveyed were overexposed to RF radiation in excess of the current OSHA standard. Recommendations are presented on page 3 of this report.

KEYWORDS: SIC 3825 (Instruments for Measuring and Testing of Electricity and Electrical Signals), radiofrequency sealers.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the potential health effects of agents found in the work place. In July 1980, Carefree of Colorado requested NIOSH to conduct such an investigation of their RF plastic sealing systems. This survey was performed on July 31, 1980.

III. BACKGROUND

The Carefree of Colorado manufactures camping awnings and camper tents. All of the seams and edges are made using RF sealers. The three sealing systems were manufactured by Thermatron, Model KF.75, power output of 7.5 kilowatts.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

The intensity of the electric and magnetic fields emitted from three plastic sealing systems were measured. All field strength readings were corrected for duty cycle. The duty cycle is the time that the RF field is on divided by the sum of the time the RF field is on and off during the operation cycle. Therefore, the measurements represent the maximum possible exposure to the operator in the measured field. The correction for the work cycle would effectively time-weight the exposure over an 8-hour day.

The electromagnetic fields were measured with a Narda Broad-Band Isotropic Radiation Monitor, Model 25540, with an electric field probe, Model 8644, and a magnetic field probe, Model 8635. Each system was surveyed by slowly scanning various parts of the worker operating the system.

B. Medical

Current sealers were interviewed and one ex-sealer still working for the company was also seen.

V. EVALUATION CRITERIA

The absorption of excessive RF energy by humans may cause adverse thermal effects due to heating of deep body tissue. The current OSHA standard (Reference 1) which limits exposures to below 10 milliwatts per square centimeter (mW/cm^2) averaged over any 0.1-hour period was promulgated to protect against thermal effects. In the far field, a power density of $10 \text{ mW}/\text{cm}^2$ is equivalent to an electric field strength of $40,000 \text{ volts}^2/\text{meter}^2$ (V^2/m^2) and a magnetic field strength of $0.25 \text{ amperes}^2/\text{meter}^2$ (A^2/m^2).

Absorption of RF energy may also result in "nonthermal" effects within the human body, which may occur without a measurable increase in tissue or body temperature. These reported "nonthermal" effects in animals at relatively low energy levels (below $10 \text{ mW}/\text{cm}^2$) include microscopic ocular changes, (References 2, 3) alterations in neuroendocrine

function, (References 4, 5) alterations in the central nervous system, (References 6, 7) behavioral changes, (References 8,9) changes in the immunologic system, (Reference 10) embryotoxic effects, (References 6, 11) and reproductive effects. (References 12, 13) Since NIOSH is concerned about these potential "nonthermal" effects, a criteria document on RF radiation has been drafted. The tentatively proposed NIOSH recommended standard is $3770 \text{ V}^2/\text{m}^2$ for the electric field and $0.03 \text{ A}^2/\text{m}^2$ for the magnetic field in the 10-400 MHz range. In the far field, these levels would be equivalent to $1 \text{ mW}/\text{cm}^2$.

VI. RESULTS AND DISCUSSION

A. Environmental

The frequency of all three sealers was 27.12 megahertz. RF measurements were made by slowly scanning various parts of the workers operating the systems. The magnetic field strength measurements ranged from non-detectable to $0.0036 \text{ A}^2/\text{m}^2$. The electric field strength readings ranged from 1296 to $416025 \text{ V}^2/\text{m}^2$. Results may be reviewed in Table 1.

B. Medical

This plant has a fairly high turnover rate and workers were all quite young. Of the three current sealers, one had received a burn on his chest when he rested against metal during sealer use. One sealer complained of some eye fatigue attributed to the necessity of matching colors all day. Otherwise there were no complaints. Job time as a sealer varied from four years (non-continuous) to one and one-half years.

No reproductive problems had been noted; however, only one current and one ex-sealer had sought to become parents while working as sealers. Each successfully fathered two normal children.

VII. CONCLUSION

Electrical field strengths range from 1296 to $416,025 \text{ V}^2/\text{m}^2$ and exceeded the OSHA standard of $40,000 \text{ V}^2/\text{m}^2$. The magnetic field strength measurements did not show a health hazard.

Except for burns, there are no currently demonstrable ill effects.

Either shielding or placing the worker at a greater distance from RF sealer to prevent overexposure should be initiated immediately.

VIII. RECOMMENDATIONS

1. Shielding should be provided to prevent workers' overexposures. (This shielding is available from most RF sealer manufacturers.)

2. Management should consider the posting of warning signs as indicated in 29 CFR 1910.97(a)(3).
3. Additional surveys should be conducted when new systems are installed or when modifications of existing systems are made.

IX. REFERENCES

1. OSHA Safety and health Standards (29 CFR 1910), 1910.97 Nonionizing Radiation, U.S. Department of Labor, Occupational Safety and Health Administration, Rev. November 7, 1978.
2. Balutina A.P. and T.L. Korobkova: Pathohistological Alteration in the Eyes of the Rabbits Exposed to SHF-UHF Radiation. Gig. Tr. Prof. Zabol. 13(4):57-58, (1969) (Rus).
3. Tajchert, J. and E. Chmurko: Investigations on the Cataractogenic Influence of Microwaves of 10 cm Band. Klin. Oczna. 42:979-83, (1972) (Pol).
4. Novitskii, A.A., B.F. Murashov, P.E. Krasnovaev and N.F. Markizova: Functional State of the Hypothalamus - Hypophysis-Adrenal Cortex System as a Criterion in Setting Standards for Superhigh Frequency Electromagnetic Radiation. Voen. Med. Zh. (8):53-56 (1977) (Rus).
5. Zalyubovskaya, N.P. and R.I. Kiselev: The Effect of Radio Waves of a Millimeter Frequency Range on the Body of Man and Animals. Gig. Sanit. 43(8):35-39 (1978) (Rus).
6. Gordon, A.V., Y.A. Lobanova, I.A. Kitsovskaya and M.S. Togskeya: Biological Effect of Microwaves of Low Intensity. Med. Electron. Biol. Eng. 1:67-69 (1963).
7. Dumanskii, J.D. and M.G. Shandala: The Biologic Action and Hygienic Significance of Electromagnetic Fields of Superhigh and Ultrahigh Frequencies in Densely Populated Areas, in Biologic Effects and Health Hazard of Microwave Radiation -- Proceedings of an International Symposium, Warsaw, October 15-18, 1973. Warsaw, Polish Medical Publishers, 1974, pp. 289-093.
8. Frey, A.H. Behavioral Effects of Electromagnetic Energy, in Hazard DG (ed.): Symposium on Biological Effects and Measurement of Radio Frequency/Microwaves -- Proceedings of a Conference, Rockville, February 16-18, 1977, HEW Publication No. (FDA) 77-8026. Rockville, U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, 1977, pp. 11-22.
9. Gilliar, J., B. Servantic, G. Betharion, A.M. Servantic, J. Obrenovitch and J.C. Perrin: Study of Microwave-Induced Perturbations of the Behavior by the Open-Field Test into the White Rat, in Johnson CC, Shore ML (eds.): Biological Effects of Electromagnetic Waves -- Selected Papers of the USNC/URSI Annual Meeting, Boulder, Colorado, October 20-23, 1975, DHHS Publication

- No. (FDA) 77-3010. Rockville, U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, 1976, Vol. 1, pp. 175-86.
10. Serdiuk, A.M.: Biological Effect of Low-Intense Ultrahigh Frequency Fields. Vrach. Delo. (11):108-11, (1969) (Rus).
 11. Bereznitskaya, A.N. and T.Z. Rysina: Embryotropic Effects of Microwaves, in Gordon ZV (ed.): Biological Effects of Radio Frequency Fields, JPRS 63321. Arlington, Virginia, U.S. Joint Publications Research Service, 1974, pp. 230-36.
 12. Bereznitskaya, A.N. and I.M. Kazbekov: Studies on the Reproduction and Testicular Microstructure of Mice Exposed to Microwaves, in Gordon ZV (ed.): Biological of Effects of Radio Frequency Electromagnetic Fields, JPRS 63321. Arlington, Virginia, U.S. Joint Publications Research Service, 1974, pp. 221-29.
 13. Varma, M.M. and E.A. Traboulay, Jr.: Biological Effects of Microwave Radiation on the Testes of Swiss Mice. Experientia 31:301-02, (1975).

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Service, 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. Carefree of Colorado.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health
5. State Designated Agency

For the purpose of informing all 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 1

Radiofrequency (RF) Sealers Electric Field and
Magnetic Field Measurements

Carefree of Colorado
Broomfield, Colorado

July 31, 1980

Machine Name	Body Location	Average Electric Field V^2/m^2 Corrected for Duty Cycle	Average Magnetic Field A^2/m^2
Maggie	Face	10,404	ND
	Chest (hands)	1,296	0.004
	Groin	3,844	0.004
	Thigh	12,996	0.0001
	Knee	38,809	0.0004
	Ankle	51,984	ND
Euonomous	Face	260,100	0.0009
	Chest (hands)	260,100	0.0009
	Waist	25,921	0.0004
	Groin	20,736	0.0004
	Knee	285,156	0.0001
	Ankle	207,936	ND
Ichabod	Face	416,025	ND
	Chest (hands)	260,100	0.0004
	Waist	130,321	0.0001
	Groin	64,516	0.0004
	Knee	130,321	0.0004
	Ankle	130,321	0.0004
OSHA STANDARD		40,000	0.25

ND = non-detectable

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