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.
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 volts$^2$/meter$^2$ (V$^2$/m$^2$); magnetic field strengths ranged from non-detectable (ND) to 0.0036 amperes$^2$/meter$^2$ (A$^2$/m$^2$). 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 V$^2$/m$^2$ - E field and 0.25 A$^2$/m$^2$ - 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 workplace. 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/cm²) averaged over any 0.1-hour period was promulgated to protect against thermal effects. In the far field, a power density of 10 mW/cm² is equivalent to an electric field strength of 40,000 volts/meter² (V/m²) and a magnetic field strength of 0.25 amperes/meter² (A/m²).

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 mW/cm²) 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 $1 \text{ mW/cm}^2$.

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


X. AUTHORSHIP AND ACKNOWLEDGMENTS

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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.
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

<table>
<thead>
<tr>
<th>Machine Name</th>
<th>Location</th>
<th>Electric Field $V^2/m^2$</th>
<th>Magnetic Field $A^2/m^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maggie</td>
<td>Face</td>
<td>10,404</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>Chest (hands)</td>
<td>1,296</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Groin</td>
<td>3,844</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Thigh</td>
<td>12,996</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Knee</td>
<td>38,809</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Ankle</td>
<td>51,984</td>
<td>ND</td>
</tr>
<tr>
<td>Euonous</td>
<td>Face</td>
<td>260,100</td>
<td>0.0009</td>
</tr>
<tr>
<td></td>
<td>Chest (hands)</td>
<td>260,100</td>
<td>0.0009</td>
</tr>
<tr>
<td></td>
<td>Waist</td>
<td>25,921</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Groin</td>
<td>20,736</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Knee</td>
<td>285,156</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Ankle</td>
<td>207,936</td>
<td>ND</td>
</tr>
<tr>
<td>Ichabod</td>
<td>Face</td>
<td>416,025</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>Chest (hands)</td>
<td>260,100</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Waist</td>
<td>130,321</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>Groin</td>
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<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Knee</td>
<td>130,321</td>
<td>0.0004</td>
</tr>
<tr>
<td></td>
<td>Ankle</td>
<td>130,321</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

OSHA STANDARD: 40,000 $V^2/m^2$, 0.25 $A^2/m^2$

ND = non-detectable