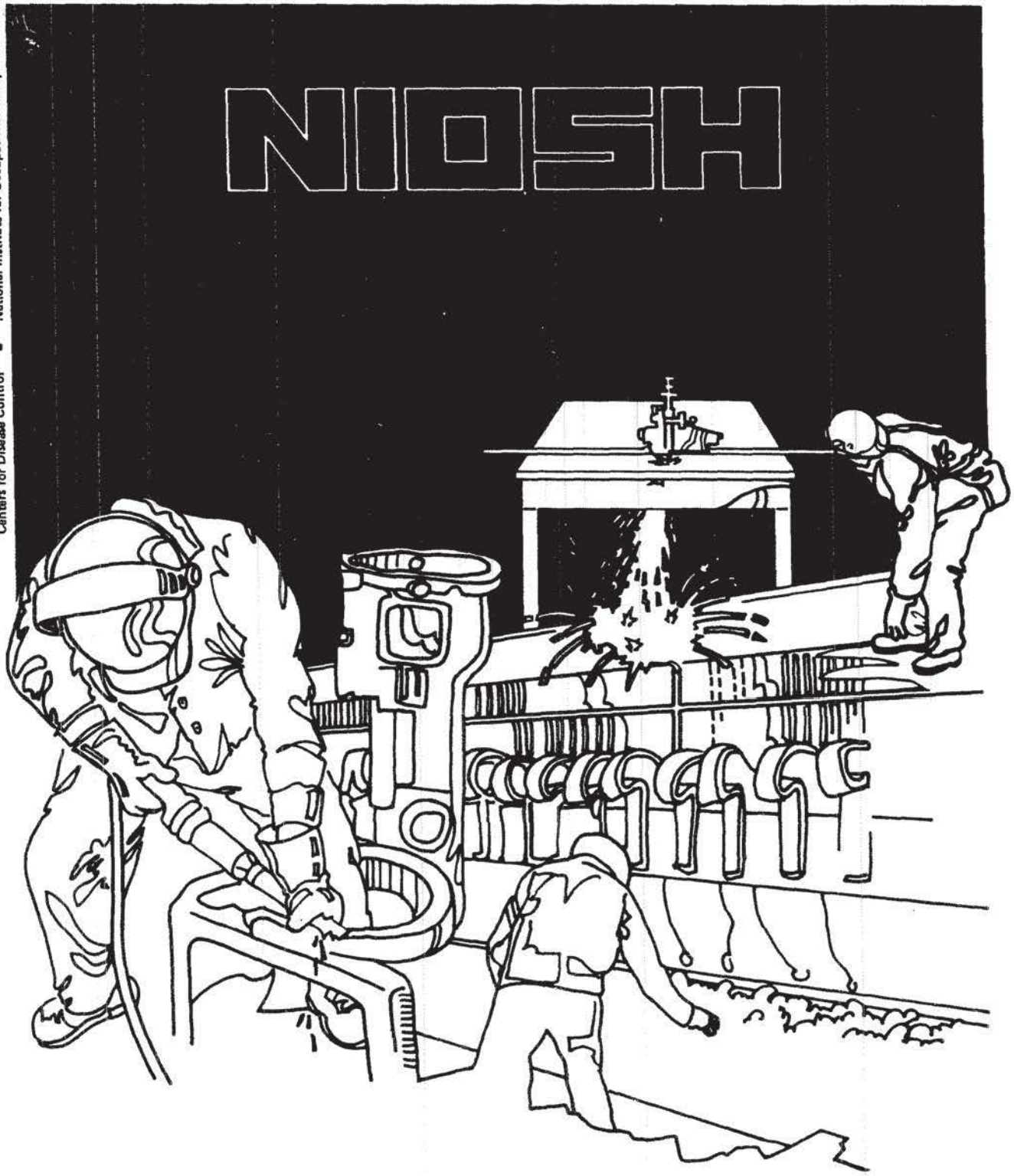
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 82-048-1132
TAYLOR LOCK COMPANY, INC
PHILADELPHIA, PENNSYLVANIA

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 82-048-1132
June 1982
Taylor Lock Company, Inc.
Philadelphia, Pennsylvania

NIOSH Investigators:
Frank A. Lewis, R.I.H.
William E. Shoemaker, RIH, RPC

I Summary

On November 30, 1981, NIOSH received a request for technical assistance from the Taylor Lock Company to evaluate the potential health effects of a new radio frequency heat sealing machine. The heat sealer operators had complained of experiencing dizziness and headaches when working at the machine.

On January 7, 1981, electric (E) and magnetic (H) field strength measurements of RF radiation were taken at the eyes, neck, chest, waist, gonads, knees, ankles and hands of the operators of the RF heat sealer. Exposures, when corrected for frequency response and duty cycles of the machines, ranged from 0.25×10^4 Volts squared per meter squared (V^2/m^2) to 1.69×10^5 V^2/m^2 for the E field and from 0.0032 Amperes squared per meter squared (A^2/m^2) to 0.482 A^2/m^2 for the H field. The current OSHA standard of 10 mw/cm^2 is equivalent to 4×10^4 V^2/m^2 for the E field and 0.25 A^2/m^2 for the H field.

When corrected for the duty cycle and frequency response the RF radiation exposures from the Thermatron KF 41 heat sealer unit exceeded the OSHA exposure limits for both the E and H fields. Therefore, NIOSH has concluded that there is a RF radiation hazard to the operator at the unloading end of the machine. Recommendations are made in this report to reduce the RF radiation exposure to the worker.

KEYWORDS: SIC 3429 (Locks) heat sealers, nonionizing radiation (radiofrequency).

II Introduction

On November 30, 1981, NIOSH received a request for technical assistance from the Taylor Lock Company to evaluate the potential health hazard of radiofrequency RF radiation from a new heat sealer. The workplace was evaluated by reviewing production practices and measuring exposure to RF radiation of the two operators running the machine.

Discussions with the Taylor Lock Company and union representatives, insurance carrier and with the RF heat sealing machine manufacturer concerning these exposures made it necessary to return on January 25, 1982 to conduct additional measurements alongside the manufacturer's representative. These measurements were basically in agreement and indeed showed overexpsures which require that immediate remedial actions be taken.

A letter was sent out to the company on January 29, 1982 which described the survey results and measures to control the RF exposures.

III Background

A dielectric heat sealer consists of a RF radiation source, control panel, workhead (normally vertical) with die, and work table. A normal heat sealing operation joins two or more plastic parts to form a final product although other operations may be performed such as embossing. The plastic parts are placed in a holder (lower plate) on the work table of the heat sealer. When dual activation buttons are pushed simultaneously, the upper die moves downward until contact is made with the tabletop. As the die contacts the tabletop, the RF source is activated usually for periods of 1 to 10 seconds. The RF radiation heats the plastic at surfaces in contact with the die. As the plastic melts, a seal is formed which joins the parts together. Because of long processing times, (30 sec. to 5 min. per unit), the work cycle which is the ratio of the heat sealer on-time to the total process time is relatively low, ranging from 0.05 to 0.30. The exposure levels during the on-time of the heat sealer are lowered significantly to a account for the work cycle.

A Thermation KF 41 Heat Sealer is used at the Taylor Lock Company for the purpose of sealing of lock between two plastic "blisters" for packaging purposes. The power output is 4 KW at a tagged normal operating frequency of 27.12 MHz $\pm$ 160 Khz. Workers are located on each side of the heat sealing unit - one to place the lock into the plastic backing piece and then the top blister for sealing and the other removes the finished packaged piece. The operators work on opposite sides of the machine in a standing or sitting position.

IV Methods

Electric and magnetic field measurements were taken with the Holaday Model HI-3002 meter using two probes; a red probe for the electric field measurements and a green probe for the magnetic field measurements.

To identify the frequency of any detectable RF radiation found emanating from the sealer, a CSC Mini-Max frequency counter was used.

ALL RF measurements were taken at the eyes, neck, chest, waist, gonads, knees, ankles and hands of the two operators in real-time operations.

V Evaluation Criteria

Radiofrequency (RF) radiation is that portion of the nonionizing electromagnetic spectrum from approxmimately 0.01-300,000 megahertz (MHz). Within the RF spectrum researchers have reported biologic effects in exposed animals and humans. Of particular concern are effects associated with exposure levels below 10 milliwatts per square centimeter (mW/cm^2), the current Occupational Safety and Health Administration (OSHA) standard. These reported effects in animals include microscopic ocular changes, alterations in neuroendocrine function and in the central nervous system, behavioral changes, changes in the immunologic system, and embryotoxic and reproductive effects.

For nonionizing radiation in the radiofrequency and microwave range of 10 MHz to 100 GHz, OSHA specifies, in 29 CRF 1910.97, a power density exposure limit of 10 milliwatts/centimeter squared (mW/cm^2) averaged over any possible 6-minute period. In the far field this power density corresponds to 4×10^4 V^2/m^2 for the electric field and 1.25 A^2/m^2 for the magnetic field.

On December 4, 1979, NIOSH and OSHA issued a joint Current Intelligence Bulletin entitled, "Radiofrequency (RF) Sealer and Heaters: Potential Health Hazards and their Prevention". While not recommending a change in the current exposure limit, it did recommend precautionary measures to protect workers from unwarranted exposures to RF energy.

VI Results and Conclusion

The radiation measurements (Table I) from the RF heat sealer ranged from 0.74×10^4 V^2/m^2 to 5.0×10^5 V^2/m^2 for the E field, and from 0.10 A^2/m^2 to 1.5 A^2/m^2 for the H field. While some of the measurements indicate the potential for excessive exhposures the measured radiaiton must be corrected for frequency calibration and duty cycle before comparisons can be made with permissible exposure standards.

The frequency calibration factor for the Holaday E field probe at 27 MHz was 1.0 MHz and for the H field probe was 0.95.

The correction factor for the duty cycle is calculated by dividing the power on-time by the total time the power is on and off during a duty cycle. An operator's exposure for the day is the product of the measured radiation and duty-cycle correction factor. The RF on-time in 360 seconds was found to be 121.8 seconds dividing this by 360 seconds the duty factor obtained is 0.338.

The corrected (for duty cycle and frequency response) RF radiation exposures from the Thermation KF41 heat sealer ranged from 0.25 X 10^4 V^2/m^2 to 1.69 X 10^5 V^2/m^2 for the E field and from 0.0032 A^2/m^2 to 0.482 A^2/m^2 for the H field; some of these values exceed the current OSHA standard of 10 mW/cm^2 which is equivalent to 4 X 10^4 V^2/m^2 for the E field and 0.25 A^2/m^2 for the H field.

The two operators currently operating the RF heat sealing unit commented that they had experienced dizziness and headaches while working at the unit.

VII Recommendations

The following recommendations are made to keep exposures at a minimum:

1. Shielding should be installed to minimize occupational exposures to emissions of stray RF energy where employees may walk or stand.

2. The distance between the worker and the source of RF energy should be maintained at the greatest distance possible by means of physical barriers.

3. Additional recommendations for hazard control covering (a) Warnings and Information, (b) Medical Monitoring, and (c) Exposure Measurements are covered in Appendix V of the Joint NIOSH/OSHA Current Intelligence Bulletin [1]. These recommendations should be reviewed and implemented where appropriate.

VIII Authorship and Acknowledgements

Evaluation conducted and report prepared by: Frank A. Lewis, Principal Environmental Investigator
Hazard Evaluations and Technical Assistance Branch, NIOSH

Originating office: Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
NIOSH Cincinnati, Ohio

Report typed by: Mary Tomassini, Secretary, NIOSH Region III

IX Distribution and Availability of Report

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Technical Information Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through 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. Taylor Lock Company, Philadelphia, PA
2. International Union Electrical, Radio and Machine Works, AFL-CIO-CLC
3. NIOSH Region III
4. OSHA Region III

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

X References

1. Radiofrequency (RF) Sealers and Heaters: Potential Health Hazards and Their Prevention, Current Intelligence Bulletin 33, DHEW (NIOSH) Publication #80 107, Cincinnati, December 4, 1979, 18 pp.

2. Occupational Exposures to Radiofrequency Radiation (18031(MHz)) From RF Dietectric Heat Sealers, American Industrial Hygiene Association Journal, Volume 43, No. 3, March 1982.

TABLE I

RADIOFREQUENCY MEASUREMENT ON HEAT SEALER

Taylor Lock Company, Inc.
Philadelphia, Pennsylvania

January 7, 1982

HETA 82 048

Location	Electric Field Strength				Magnetic Field Strength			
	Monitor Reading V^2/m^2	X F C.#	X D. F.*	Corrected Reading (V^2m/m^2)	Monitor Reading (A^2/m^2)	X F. C.#	X D. F.*	Corrected Reading (A^2/m^2)
Operator #1								
Eyes (loading)	$1.5X10^4$	1	0.338	$0.51X10^4$	0.023	0.95	0.338	0.007
Neck	$0.75X10^4$	1	0.338	$0.25X10^4$	0.030	0.95	0.338	0.010
Chest	$1.0X10^4$	1	0.338	$0.34X10^4$	0.065	0.95	0.338	0.021
Waist	$3.75X10^4$	1	0.338	$1.27X10^4$	0.080	0.95	0.338	0.026
Gonads	$5.0X10^4$	1	0.338	$1.69X10^4$	0.025	0.95	0.338	0.008
Knees	$3.75X10^4$	1	0.338	$0.85X10^4$	0.050	0.95	0.338	0.016
Ankles	$2.50X10^4$	1	0.338	$0.85X10^4$	0.040	0.95	0.338	0.013
Hands	$4.0X10^4$	1	0.338	$1.35X10^4$	0.025	0.95	0.338	0.080
Operator #2								
Eyes (Unloading)	$8.5X10^4$	1	0.338	$2.87X10^4$	1.50	0.95	0.338	0.048
Neck	$3.5X10^4$	1	0.338	$1.18X10^4$	2.25	0.95	0.338	0.072
Chest	$5.5X10^4$	1	0.338	$1.86X10^4$	2.25	0.95	0.338	0.072
Waist	$6.5X10^4$	1	0.338	$2.20X10^4$	2.00	0.95	0.338	0.064
Gonads	$5.5X10^4$	1	0.338	$1.86X10^4$	0.75	0.95	0.338	0.024
Knees	$3.0X10^4$	1	0.338	$1.01X10^4$	0.10	0.95	0.338	0.003
Ankles	$0.5X10^5$	1	0.338	$1.69X10^4$	0.50	0.95	0.338	0.016
Hands	$.5X10^5$	1	0.338	$1.69X10^5$	1.50	0.95	0.338	0.482

F.C. = Frequency Correction Factor
* D.F. = Duty Factor = R.F. "on" Time in 360 secs. / 360 secs.