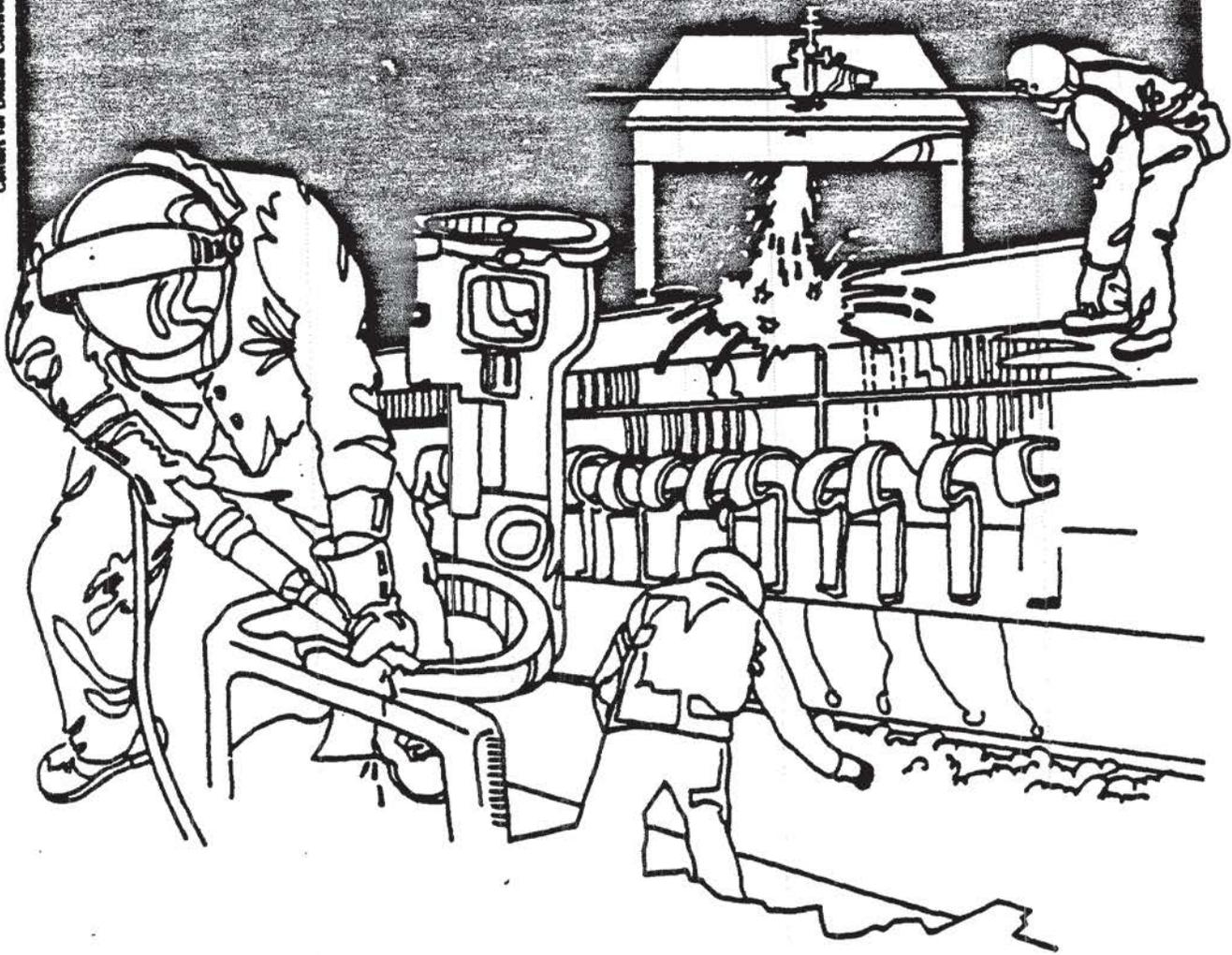


# NIOSH



## Health Hazard Evaluation Report

HETA 84-476-1647  
KIMBALL INTERNATIONAL  
UPHOLSTERED PRODUCTS, INC  
JASPER, INDIANA

## 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.

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

HETA 84-476-1647  
January, 1986  
KIMBALL INTERNATIONAL UPHOLSTERED PRODUCTS, INC.  
JASPER, INDIANA

NIOSH INVESTIGATOR:  
William E. Murray

I. SUMMARY

On August 14, 1984, NIOSH received a request for technical assistance from the Indiana State Board of Health to aid in evaluating radiofrequency radiation (RFR) exposures at Kimball International Upholstered Products, Inc., Jasper, Indiana. The RFR is emitted by two dielectric heaters (Model 36 operating at 7.6 MHz and Model 42 operating at 6.5 MHz) used in a gluing process in the production of office furniture subassemblies.

On September 14, 1984, electric (E) and magnetic (H) field strengths were measured around these dielectric heaters, emphasizing the exposure of the operators to RFR. The time-weighted operator exposure (E-field) ranged from not detectable (ND) to  $330 \text{ V}^2/\text{m}^2$  compared to the Food and Drug Administration's guideline of  $59,200 \text{ V}^2/\text{m}^2$  (Model 36) and  $81,900 \text{ V}^2/\text{m}^2$  (Model 42). The time-weighted operator exposures (H-field) ranged from ND to  $0.008 \text{ A}^2/\text{m}^2$  compared to the FDA guideline of  $0.47 \text{ A}^2/\text{m}^2$  (Model 36) and  $0.64 \text{ A}^2/\text{m}^2$  (Model 42). Emissions (time-weighted) as high as  $20,000 \text{ V}^2/\text{m}^2$  and  $4.3 \text{ A}^2/\text{m}^2$  were detected at distances of 5 cm from the heaters, but the operators are not exposed at these locations under normal operating conditions. No corrective actions or control measures were required.

Operator exposures to RFR from two dielectric heaters were measured and found to be lower than the Food and Drug Administration's guidelines. NIOSH determined that there is no RFR hazard to the employees working with these heaters and no control measures need to be implemented.

KEYWORDS: SIC 2521 (Wood office furniture) heat sealers, nonionizing radiation, radiofrequency radiation.

## II. INTRODUCTION

On August 14, 1984, NIOSH received a request for technical assistance from the Indiana State Board of Health, Division of Industrial Hygiene and Radiological Health, to aid in the evaluation of radiofrequency radiation (RFR) emitted by dielectric heaters. The request was made by the Board of Health in response to a complaint to the Indiana OSHA program at Kimball International Upholstered Products, Inc., Jasper, Indiana.

## III. BACKGROUND

The Kimball plant manufactures wooden office furniture. The specific process of interest to this investigation is the assembly of wood end frames and arms for use in chairs. In this process, the wood parts are glued together. The assembled parts are then placed by the operator into a fixture in a woodwelder. The operator compresses the parts by tightening the fixture and, when the parts are secured, activates the hydraulic press which causes the top plate to descend. The top plate secures the parts in place and completes the RF circuit. The RFR is then applied to the parts and dries the glue.

The two dielectric heaters used in the process are manufactured by Nemeth Engineering Associates. The equipment is described below.

1. Nemeth Model 36 (Woodwelder). This heater operates at a frequency of 7.6 megahertz (MHz) (tagged 5-6 MHz) with an output power of 3 kilowatts (kW). End frames are processed in this unit. The frames are placed in the fixture by the operator(s) standing in front of the unit. The RFR is activated for 15 seconds (s) for each frame and about 700 pieces are produced in a 9-hour shift.
2. Nemeth Model 42 (Woodwelder). This model is similar to the one above except that the plates are slightly larger. This heater operates at a frequency of 6.5 MHz (tagged 5-6 MHz) with an output power of 3 kW. End frames and arms are processed in this unit. The operation is the same but the RFR is activated for 40s per piece and 400 pieces are produced in a 9-hour shift.

## IV. METHODS

As mentioned above, these heaters operate at frequencies of 7.6 MHz (Model 36) and 6.5 MHz (Model 42). At these frequencies, the operators are working in the near-field and the electric and magnetic field strength must be measured separately to determine whether exposures exceed the guidelines.

A Holaday Model HI 3003 (SN 33170) (Holaday Instruments, Inc., Eden Prairie, MN) and two probes were used to perform the survey. The electric field strength was measured in units of volts squared per meter squared ( $V^2/m^2$ ) with a Model STE-03 probe (SN 421 HR). The overall accuracy is  $\pm 1.5$  dB and the minimum detectable level is about  $500 V^2/m^2$ . This probe is used for the frequency range of 0.5 to 6000 MHz.

The magnetic field strength was measured with a Model STH-03 probe (SN 188) in units of amperes squared per meter squared ( $A^2/m^2$ ). The overall accuracy is  $\pm 3.0$  dB and the minimum detectable level is about  $0.005 A^2/m^2$ . This probe is used for the frequency range of 5 to 300 MHz.

The meter and probes were calibrated by the manufacturer on February 21, 1983 and the calibration was checked before the survey was conducted.

The RFR frequencies were measured with a Hewlett-Packard Model 5303/5303B (SN1520A02460/1452A0228) Frequency Counter/Measuring System mainframe and a Singer Model 90700-2 antenna loop. This meter responds to frequencies from DC to 525 MHz.

In measuring the operator exposures, the process was observed several times to determine the operator's location during the time the RFR is being generated. The maximum exposure was determined by measuring the field strength at various body sites from the eyes to the ankles at the closest distance to the heater occupied by the operator. In addition, the emissions from the heater were measured by scanning around accessible locations with the probe.

## V. EVALUATION CRITERIA

### A. BIOLOGICAL EFFECTS

The RF energy emitted by dielectric heaters can penetrate a worker's body and cause heating of internal tissues. The body's heat sensors are located in the skin and may not readily sense heating deep within the body. Thus, heater operators may absorb large amounts of RF energy without being aware of it. Because most operators are intermittently exposed, there is less heating of body tissues than from continuous exposure. Nevertheless, in some cases, the exposure levels are so high that the heating has been sensed by the operator.

Animal studies have shown that exposure to high levels of RF radiation can cause considerable harm due to the excessive heating of body tissues. High intensity exposures can produce adverse effects in a number of body systems including the reproductive, ocular, cardiovascular, immune and central nervous systems. Such exposures can cause severe heating leading to hyperthermia and death if exposure persists.

There have been many reports of adverse effects in humans. Although many of the effects noted in both case reports and epidemiologic studies are plausibly related to RF exposure, the reports and studies are not sufficiently reliable to allow predictions of adverse effects at given exposure levels. These studies in conjunction with the animal experiments do indicate the need to establish a standard to protect the workers from suffering adverse effects from RF exposure.

#### B. OCCUPATIONAL EXPOSURE STANDARDS

Occupational exposure standards for RF radiation have been established by private organizations, Federal agencies and private companies. Rather than extensively discussing all the standards, the guidance established by the FDA will be described here. This guidance is especially appropriate since it applies specifically to dielectric heaters.

To ensure that exposure of personnel is minimized, FDA recommends that radiofrequency sealers and dielectric heaters not be operated in a manner which will expose personnel to electric or magnetic fields exceeding the applicable limits in the American National Standards Institute (ANSI) C95.1 (1982) Standard. The limits applicable to the heaters evaluated in this investigation are presented in Table 1.

The FDA recommendation applies to: (1) the RF Frequency range of 3 MHz through 100 MHz, (2) The Worst-Case Conditions of use, and (3) exposures averaged over any six-minute period (Duty Cycle).

#### VI. RESULTS

The measured electric and magnetic field strengths are given in Table 1 for each unit. The emissions from the front and sides of each unit were measured at a distance of 5 cm from the unit and are not accessible to the operator. The RFR exposures at the point of closest approach by the operator are also shown and represent the actual operator exposures. The FDA exposure guidelines are also shown.

The FDA guidance requires that the exposures be time-weighted over a 0.1 hr period. This is done by multiplying the meter reading by the appropriate duty cycle. This factor is the fraction of time the RF power is on during the process time. An average duty cycle (DC) was calculated as follows.

On the Model 36, 700 frames are produced in a 9-hour shift. The RF is applied for 15s and would be on for 10,500 s during a shift (9 hr is equal to 32,400s). Thus,

$$\text{DC (Model 36)} = \frac{\text{RF on time}}{\text{Shift time}} = \frac{10,500 \text{ s}}{32,500 \text{ s}} = 0.33$$

Using an RF on time of 40s per piece and 400 pieces per shift, a similar calculation yields a duty factor of 0.50 for the Model 42. These factors appear in Table 1, along with the meter readings and corrected values obtained by multiplying the meter readings by the appropriate duty cycle.

None of the electric field strengths exceeded the FDA guideline as can be seen in Table 1. The magnetic field strength emissions at 5 cm were higher than the guideline but it is important to remember that the operator is not exposed to these levels because the operator normally stands at least 30 cm from the heater. The operator's exposure was below the detection limit of the instrument for the Model 36 and well below the guideline for the Model 42.

#### VII. RECOMMENDATIONS

The measurements demonstrate that the operators (in their normal operating position) are not exposed to RFR above the ANSI guidelines. Although no recommendations are needed to reduce exposure, the operators should be cautioned not to stand closer than normal (30 cm) to the heater when the RF power is activated.

#### VIII. AUTHORSHIP AND ACKNOWLEDGMENTS

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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 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. Indiana State Board of Health
2. Kimball International Upholstered Products, Inc.
3. NIOSH, Region V
4. OSHA, Region V

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. Food and Drug Administration (FDA), Guidance for Radiofrequency Sealers and Dielectric Heaters. Rockville, MD, FDA, 1985.
2. Environmental Protection Agency (EPA), Biological Effects of Radiofrequency Radiation. Research Triangle Park, NC, EPA, 1984.

TABLE 1

RADIOFREQUENCY RADIATION MEASUREMENTS ON DIELECTRIC HEATERS  
 KIMBALL INTERNATIONAL FURNITURE PRODUCTS  
 JASPER, INDIANA  
 SEPTEMBER 14, 1984  
 HETA 84-476

	Frequency (MHz)	Duty Factor	Electric Field Strength ( $V^2/m^2$ )		Magnetic Field Strength ( $A^2/m^2$ )	
			Meter Reading	Corrected Value	Meter Reading	Corrected Value
Model 36	7.6	0.33				
Emission (5 cm)						
front			1,500	500	2.50	0.83
left side			2,000	660	2.50	0.83
right side			4,000	1,300	3.00	1.00
Operator exposure (30 cm)			1,000	330	0.005	0.002
FDA guideline				59,200		0.47
<hr/>						
Model 42	6.5	0.50				
Emission (5 cm)						
front			500	250	2.50	1.30
left side			40,000	20,000	8.50	4.30
right side			4,500	2,250	1.50	0.75
Operator exposure (30 cm)			500	250	0.015	0.008
FDA guideline				81,900		0.64

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