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## **NIOSH HEALTH HAZARD EVALUATION REPORT:**

**HETA #2001-0483-2884**  
**Immigration and Naturalization Service**  
**San Diego, California**

**November 2002**

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DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



## PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

HETAB also provides, upon request, technical and consultative assistance 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 NIOSH.

## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Teresa Seitz and Debra Feldman of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Ultraviolet radiation measurements were made by Ken Martinez of NIOSH, and Gene Moss, Consultant. Desktop publishing was performed by David Butler. Review and preparation for printing were performed by Penny Arthur.

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## Highlights of the NIOSH Health Hazard Evaluation

### Evaluation of Eye and Skin Problems Among INS Immigration Inspectors

NIOSH was asked to assist INS in an investigation of eye and skin problems among Immigration Inspectors at the San Diego International Airport. The health problems began shortly after working in the newly remodeled work area and were thought to be possibly related to the use of ultraviolet radiation (UV) lamps used to verify authenticity of documents from international travelers.

#### What NIOSH Did

- We visited the work area of concern.
- We measured the levels of UV radiation that came from the lamps.
- We looked at medical records of affected employees.
- We looked at the manufacturer's specifications for the lamps.

#### What NIOSH Found

- The UV lamps contained two tubes – a UV-A tube and a UV-C tube.
- Only the UV-A tube was needed for document verification.
- The levels of UV-C radiation were above the occupational exposure limits when close to the lamps.
- The eye and skin problems were consistent with UV-C overexposures.
- The levels of UV-A radiation alone would not be expected to cause the reported health problems.
- Eye and skin problems were not reported after the UV-C tubes were removed.

#### What Immigration and Naturalization Service Managers Can Do

- Continue to use only the UV-A tubes.
- Check the UV-A output levels of the tubes before buying new tubes or new lamps.
- Avoid exposure to the workers' eyes by shielding units from direct contact.
- Review workers' medical history to determine if increased sensitivity to UV radiation is a concern.
- Educate employees on reasons for use of lamps, possible hazards, and what is being done to reduce UV exposures.

#### What the Immigration and Naturalization Service Employees Can Do

- Do not look directly at the lamp.
- Limit the time of skin exposure to a few seconds per use.
- Tell your doctor about any skin or eye problems that appear.
- Do not use broken or damaged lamps.
- Do not remove protective covers on lamps.

#### What To Do For More Information:

We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for HETA Report #2001-0483-2884



**Health Hazard Evaluation Report 2001-0483-2884  
Immigration and Naturalization Service  
San Diego, California  
November 2002**

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## **SUMMARY**

In August 2001, the National Institute for Occupational Safety and Health (NIOSH) received a request from the San Diego District of the Immigration and Naturalization Service (INS) for technical assistance in evaluating reports of skin and eye problems among Immigrations Inspectors at the San Diego International Airport. Shortly after moving into a newly renovated space at the airport, 9 of 12 Inspectors reported symptoms of eye irritation, itching, burning, and redness. Some also reported skin rash. An indoor environmental quality investigation did not identify any chemical or biological contaminants that could be considered as the source of the problem. Further investigation revealed that new ultraviolet (UV) lamps had been purchased. UV lamps are routinely used to verify the authenticity of documents submitted by international passengers. The new lamps were found to contain two tubes—one UV-A tube and one UV-C tube. Because the UV-C tube is not needed for document verification and was considered to be a potential cause of the reported health problems, it was removed from the lamps. NIOSH was then asked to further evaluate potential UV radiation exposures to INS Inspectors.

NIOSH visited the facility and measured UV-C irradiance levels at one of the booths where the lamps were used. A UV-C tube was re-installed prior to measurement. At 254 nanometers (nm), the predominant UV wavelength emitted by the UV-C lamp, irradiance levels exceeded 465 microwatts per square centimeter ( $\mu\text{W}/\text{cm}^2$ ) at ten inches from the lamp. This irradiance level results in a permissible exposure time of less than 15 seconds for workers with unprotected eyes and skin. At 18 inches from the lamp and a height of 56 inches above the floor (approximating the potential exposure to the eyes) the measured irradiance was around  $5 \mu\text{W}/\text{cm}^2$  corresponding with a permissible exposure time of approximately 20 minutes. Thus, under typical conditions of use, employees could be overexposed to UV-C radiation in seconds to minutes depending on the actual distance of the unprotected eyes or skin to the lamp. UV-A irradiance levels were later measured on one unit at an off-site location. Under typical conditions of use, results indicated that exposure to the employees' eyes would not likely exceed the applicable occupational exposure limits for UV-A radiation.

A review of medical information for the affected employees revealed that three of nine inspectors with eye symptoms also reported rash associated with itching, irritation, and reddening of the skin, primarily on the face, neck, and forearms. Eye symptoms reported by employees included blurred vision, burning eyes, intense pain, watery eyes, swollen eyes, and temporary loss of vision. Six employees filed "CA-1" forms (notification of work-related illness or injury), and all six were diagnosed and treated for conjunctivitis; three employees were also diagnosed with "allergic dermatitis." Three of the nine symptomatic Inspectors did not file a CA-1 but sought medical attention privately. Those records were not available for review, although all three reported that they had been diagnosed with conjunctivitis by their physicians. Most workers' symptoms reportedly resolved within 3–6 days. Two of the three Inspectors who did not report any eye or skin symptoms indicated that they had not used

the lamps. There were no further reports of skin or eye problems since the UV-C tubes were removed from the lamps.

The environmental measurements indicate that the UV lamps used by INS Inspectors at the San Diego International Airport in March 2001 emitted high levels of UV-C radiation, representing a health hazard to those with close and direct contact with the lamps. The symptoms and signs reported by INS Inspectors are consistent with occupationally-induced photokeratitis and conjunctivitis due to UV-C overexposure. Recommendations are made in this report to prevent future problems resulting from the use of UV lamps for document verification.

Keywords: SIC 9721 (Immigration Services-Government), INS, immigration, international, airport, ultraviolet radiation, germicidal lamp, UV-A, UV-C, photokeratitis, conjunctivitis.

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## INTRODUCTION

In August 2001, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Safety Manager of the San Diego District Immigration and Naturalization Service (INS), San Diego, California, to provide technical assistance in an investigation of reports of skin and eye problems among Immigrations Inspectors at the San Diego International Airport. A NIOSH industrial hygienist visited the facility on August 6, 2001, to conduct an environmental evaluation and obtain additional information concerning the problem. Medical information from affected employees was reviewed by a NIOSH physician. Literature from the lamp manufacturer was also reviewed. This final report presents a summary of our findings and recommendations.

## BACKGROUND

On March 11, 2001, Terminal 2 of the San Diego International Airport was returned to the use of the San Diego District of the INS after a period of remodeling. Immigrations Inspectors resumed their duties in the inspection booths at this terminal on March 18, 2001. This included the inspection of documents from arriving international passengers. From March 24 to March 28, 2001, 9 of 12 inspectors reported symptoms of eye irritation, itching, burning, and redness. Some also reported skin rash.

As a result of the cluster of illnesses described above, an industrial hygiene consulting firm was called in to investigate. The consultants conducted an indoor environmental quality investigation and performed air and surface sampling for bacteria, fungi, and chemical agents. The following results from that evaluation were reported to NIOSH by the INS Safety Manager:

- Formaldehyde, total dust, and volatile organic compounds were not detected in any air samples.

- The mold and pollen found in the indoor air were of the same species as those found outdoors, and the indoor concentrations were lower than outdoors.
- Mold and pollen were not detected in any of the indoor surface samples.
- Bacterial species normally associated with conjunctivitis were not isolated in the air samples.

The conclusion was made that the sample results did not indicate a health hazard from airborne chemicals, mold, pollen, or bacteria. To reduce the spread of bacterial illness, recommendations were made for employees to wash hands frequently and to keep surfaces in the work area clean. Surface cleaning of the work area was reportedly performed on several occasions by the San Diego Unified Port District.

In April 2001, after completion of the above evaluation, the Safety Manager spoke with NIOSH regarding the problem. The NIOSH industrial hygienist suggested that since no chemical or microbial cause was identified, another possible source of the employees' symptoms may be the ultraviolet lights used by airport inspectors to verify authenticity of documents. Special dyes and inks used in passport and other documents fluoresce when placed within a few inches of an ultraviolet radiation source, typically a source with wavelengths in the UV-A region. As a result of this conversation, another private industrial hygienist was hired to conduct a separate investigation. This investigation revealed that the new UV lights were positioned in such a way that they shone directly on anyone who plugged in the UV assembly. Further investigation revealed that the Dallas district used UV lamp assemblies that had shields to prevent direct exposure to workers. Employees were informed that they should not keep the lamps on continuously but only use as necessary. To turn off the lamps, the employees would unplug the entire assembly from the outlet.

Information obtained from specification sheets from the lamp manufacturer revealed that the lamp contained two lamps: one UV-A black light fluorescent tube and one UV-C germicidal tube.

Two switches are present on each of the six fixture assemblies—one to enable the UV-A tube and the other to enable the UV-C tube. The manufacturer had stated that both switches should never be on simultaneously. In July 2001, five of six assemblies at the terminal had both switches in the “on” position, and in the remaining assembly only the UV-C switch was on. Because the document verification process requires only UV-A, the Safety Manager recommended that the UV-C tubes be removed permanently from these lamps and that a sign be placed near the lamps informing inspectors of the potential hazard and the need to shield eyes from direct exposure. He also recommended that the results of his evaluation be shared with all INS Districts and Sectors and that a survey of UV lamp use at other INS facilities be conducted.

## METHODS

### Environmental Evaluation

Additional information was obtained from the manufacturer regarding the UV lamps used by INS, including relative spectral energy distribution curves for the UV-A and UV-C tubes, and the operations manual. On August 6, 2001, a NIOSH Industrial Hygienist visited the work area. Because it was suspected that UV-C radiation may have been a cause of the eye and skin problems, measurements were made to determine the UV-C levels emitted by the lamps at various distances from the source. The measurement system used to evaluate occupational exposures to UV-C radiation consisted of a calibrated International Light model IL 1400A radiometer connected to an SEL 240 detector (International Light Inc., Newburyport, Massachusetts). A suitable radiometer was not available to measure the UV-A emissions, thus measurements were made with the UV-C tube operating and the UV-A switch turned off. Because the UV-C tubes had been removed due to safety concerns, the tubes were re-installed at the time of the NIOSH visit so that measurements could be made to quantify the UV-C irradiance levels to which employees were likely exposed in March 2001. Measurements were made at Booth 2 with the lamp

in the position that it is was typically used (slightly angled).

The Safety Manager later sent one of the Spectronics lamps to NIOSH for further evaluation of the UV-A component. This lamp was sent to a consultant for measurement along with an 18 inch RadioShack Model 42-3055 fluorescent black light purchased by NIOSH for comparison purposes. The RadioShack lamp contained one 15W black light (GE F15T8-BLB) and no UV-C tube. The RadioShack lamp was believed to be similar to that used at another INS facility, without incident, for document verification. On March 7, 2002, UV-A levels were measured using a calibrated International Light model IL 1700 system with UV-A detector/filter combination (320 nanometers [nm]–400 nm) (International Light, Inc., Newburyport, Massachusetts). All measurements were made at the middle of the source and at a position off a metal table that brought the detector into the center of the lamp source. At least five different measurements were made and the results were averaged.

### Medical Evaluation

A NIOSH Medical Officer reviewed “CA-1” (notification of work-related illness or injury) forms submitted by Immigration Inspectors and worker’s compensation records.

## EVALUATION CRITERIA

### Ultraviolet Radiation (UVR)

Ultraviolet radiation (UVR) is an invisible radiant energy produced naturally by the sun and artificially by arcs operating at high temperatures. Germicidal and black light lamps are examples of artificially produced UV sources. UVR is a form of electromagnetic radiation with wavelengths between the visible spectrum and the X-ray region. The International Commission on Illumination (CIE) has divided the wavelengths between 100 nm and 400 nm into three wavelength bands: UV-A (long wavelengths, range: 315–400 nm), UV-B (midrange



wavelengths, range: 280–315 nm), and UV-C (short wavelengths, range: 100–280 nm). These spectral band designations are used to define approximate spectral regions and may vary among sources.<sup>1</sup>

The lamps used by Immigrations Inspectors in March 2001 contained both UV-A and UV-C tubes, thus the emissions were in the long and short UV wavelength regions. Information obtained from the lamp manufacturer indicates that the UV-A tubes (black light fluorescent lamps) have a peak intensity at approximately 365 nm, though they have emissions at other wavelengths in this region, including a small peak around 313 nm, near the border of the UV-A and UV-B ranges. The UV-A tubes also have peaks in the visible region (>400 nm). The UV-C tubes (germicidal lamps) have a peak intensity around 254 nm, with most of the radiant energy emitted at this wavelength.

### **Acute Effects of UVR on Eyes and Skin**

Since the eyes and skin readily absorb UVR, they are particularly vulnerable to injury. The severity of radiation injury depends on exposure time, intensity of the radiation source, distance from the source, wavelength, sensitivity of the individual, and presence of sensitizing agents. Skin exposure to UVR can result in erythema (reddening). This is a reversible injury, with the time course dependent on the severity of the burn. Erythema results most commonly from UV-B and UV-C overexposures.<sup>2</sup> The CIE suggests that the skin is most sensitive to UV radiation in the range of 250 nm to 300 nm.<sup>3,4</sup>

The cornea and conjunctiva of the eye absorb UVR, especially in the UV-B and UV-C ranges. The radiation is absorbed by the outer surface of the eye, and overexposure results in inflammation of the cornea (photokeratitis) and/or conjunctiva (conjunctivitis).<sup>5</sup> Keratoconjunctivitis is a reversible injury, lasting about 24–48 hours, but it is a debilitating condition while it runs its course. In industry this is often referred to as “welder’s flash.” The affect is intense pain, a feeling of sand in the eyes, redness, and sometimes photophobia (sensitivity to light) and lacrimation (tearing). This

condition may also be accompanied by erythema of the skin surrounding the eyelids.<sup>2</sup> There is a latent period of a few hours, depending upon the dose, so it is sometimes not recognized as an occupational injury by the worker. The American Conference of Governmental Industrial Hygienists (ACGIH<sup>®</sup>) reports that these affects rarely result in permanent eye injury.<sup>2</sup>

Longer wavelength UV-A is rarely associated with the above-mentioned health effects except in situations of prolonged and intense exposure (high irradiance levels) or when pre-existing photosensitivity is present due to use of certain medications or disease processes. Persons who have had the lens of the eye removed in cataract surgery are at increased risk from retinal injury with exposure to UV-A.<sup>6</sup>

### **Occupational Exposure Limits for UVR**

At present, the Occupational Safety and Health Administration (OSHA) does not have a permissible exposure limit for occupational exposure to UVR. NIOSH and ACGIH have established recommended exposure limits for UVR that are wavelength dependent. These limits are based primarily on studies of acute effects of UVR to humans and animals. NIOSH and ACGIH note that the recommended values do not apply to exposure of photosensitive individuals or to those concomitantly exposed to photosensitizing agents. Hundreds of agents are believed to cause hypersensitivity to UVR including some plants, some antibiotics, some antidepressants, some antipsychotic drugs, as well as some diuretics, cosmetics, dyes, and coal tar products.<sup>2</sup>

For exposure to germicidal lamps that emit predominantly 254 nm radiation, the NIOSH recommended exposure limit and the ACGIH threshold limit value (TLV<sup>®</sup>) are the same, 0.006 Joules per square centimeter (J/cm<sup>2</sup>) for a daily eight-hour work shift. To protect workers who are exposed to 254 nm radiation for 8 hours per workday, the measured irradiance should be  $\leq 0.2 \mu\text{W}/\text{cm}^2$  for an 8-hour exposure. For other

durations of exposure, the permissible exposure time (in seconds), for workers with unprotected eyes and skin, can be calculated by dividing 0.006 J/cm<sup>2</sup> (the NIOSH REL at 254 nm) by the measured irradiance level at 254 nm in W/cm<sup>2</sup>.

ACGIH and NIOSH recommend that exposure of the unprotected eyes to UV-A should not exceed a radiant exposure of 1.0 J/cm<sup>2</sup> for periods < 1000 seconds, and an irradiance of 1.0 milliwatt per square centimeter (or 1000 μW/cm<sup>2</sup>) for periods > 1000 seconds.<sup>2,5</sup> The NIOSH REL applies also to unprotected skin exposures to UV-A.

## RESULTS

### Environmental Evaluation

The lamps used by INS Inspectors were Spectroline<sup>®</sup> X-Series Bench and Display UV lamps, model XX-15NF (Spectronics Corp., Westbury, New York). These lamps contain 15W UV-A and UV-C tubes. The manufacturer's literature indicates they are suitable for use where "high-intensity, wide-area UV coverage" is needed.<sup>7</sup> These lamps were positioned directly on the workstation surface, facing the employee, and had not been permanently mounted, nor shielded from employees in any way.

Results of the UV-C measurements made at Booth 2 are shown in Table 1. Measured irradiance levels at 254 nm exceeded 465 μW/cm<sup>2</sup> at eight and ten inches from the lamp with the detector facing the lamp and placed about an inch above the workstation surface. It could be expected that employees' skin would be exposed to these UV levels for several seconds while placing a document near the lamp to look for UV fluorescence of the inks. Considering the NIOSH and ACGIH recommended levels for 254 nm radiation, permissible exposure times for the unprotected skin would be only a few seconds at these high irradiance levels. The irradiance levels we measured were consistent with the data reported by the manufacturer. The manufacturer specifications indicate that new UV-C tubes have a typical peak intensity at 10 inches of 490 μW/cm<sup>2</sup>. Lower levels

of UVR are emitted by the lamps over time as the tubes age.

At 18 inches from the lamp and a height of 56 inches above the floor (approximating the potential exposure to the eyes) the measured irradiance was around 5 μW/cm<sup>2</sup>. At this irradiance level, the permissible exposure time would be approximately 20 minutes for unprotected eyes and skin. Exposure times in excess of 20 minutes, as well as exposures closer to the source or at a reduced angle to the lamp, would result in UV-C overexposures. Based on the description of work duties, these UV-C levels and exposure times could reasonably be expected to have been experienced and may even have been exceeded in March 2001 at workstations where the lamps remained on during the time that the workers were present at their station.

The UV-A measurements made off-site, with the detector facing the unit and on the same plane as the lamp, indicated that the irradiance levels from the Spectronics lamp averaged 485 μW/cm<sup>2</sup> at 10 inches. This is in agreement with the manufacturer's literature which reports a peak UV-A irradiance of 550 μW/cm<sup>2</sup> at this distance for new tubes. For exposure times greater than 1000 seconds (approximately 17 minutes) which is applicable to this situation, the NIOSH REL and ACGIH TLV for UV-A exposures of 1000 μW/cm<sup>2</sup> would not be exceeded at 10 inches from the lamp. In fact, the exposure to the workers' eyes would likely be less than that reported above because the employees' eyes would not be positioned directly in front of the lamp but rather at some angle above the lamp, and the distance from the lamp to the eyes would typically be more than 10 inches, except possibly for a few seconds.

For the RadioShack system, with the detector positioned directly in front of the lamp, on the same plane as the lamp, the peak UV-A irradiance averaged 800 μW/cm<sup>2</sup> at 6 inches, and 190 μW/cm<sup>2</sup> at 18 inches. Again, under typical conditions of use, exposure to the employees' eyes would not likely exceed the applicable occupational exposure limits.

### Medical Evaluation

Nine of twelve inspectors reported skin and/or eye symptoms. The Safety Manager indicated that two of the employees who did not report any symptoms indicated that they had not used the lamps. Three of the nine inspectors with eye symptoms also reported rash associated with itching, irritation, and reddening of the skin—primarily on the face and neck (3) and forearms (1). Six of the nine inspectors with symptoms filed a CA-1 and sought medical attention through worker's compensation. Those records were made available to the NIOSH physician for review. Eye symptoms reported on the CA-1s included blurred, hazy vision, burning eyes, intense pain, watery eyes, swollen eyes, and temporary loss of vision. All six of those who filed CA-1s were diagnosed and treated for conjunctivitis and three were also diagnosed with “allergic dermatitis.” One of the workers required treatment with steroid medication when the gentamycin prescribed for the conjunctivitis caused them to develop iritis (inflammation of the iris). The gentamycin was discontinued and the iritis resolved. Three of the nine symptomatic inspectors did not file a CA-1 but sought medical attention privately. Those records were not available for review, although all three reported that they had been diagnosed with conjunctivitis by their physicians. With the exception of the one individual with iritis which prolonged the course of illness, all workers symptoms reportedly resolved within 3 to 6 days.

## DISCUSSION

The new UV lamps used by INS inspectors after their work area was renovated were different from those previously used, and also from those used at other INS facilities. The important difference is that the new lamps contained a high-intensity UV-C tube in addition to the UV-A tube that is typically used to verify authenticity of documents. The rationale for purchasing lamps that have wide area UV coverage was not identified by management and may simply have been a purchasing error. The manufacturer's literature and environmental measurements made as part of the NIOSH evaluation confirm that high levels of UV-C radiation emitted by these lamps

represent a health hazard to employees at close distances.

There is not sufficient information to reconstruct the actual times of exposure for individual workers, as employees moved between work areas at the International Terminal and a downtown San Diego office, depending on international flight arrivals. The actual exposure levels to which individual workers were exposed also could not be determined because inspectors move their bodies continually during the performance of their jobs during a work shift, changing the distance from the skin or eyes to the UV source. In addition, the type of clothing worn (long vs. short sleeves, tight vs. loose weave), presence of eye glasses, and presence of UV-reflecting materials on the workstation would alter the skin and eye exposures received by employees on any given workday. Despite the limitation of assessing individual worker exposures, it is clear from the measurements made at the workplace that UV-C exposures were high enough to increase the risk for overexposures even within a time period of seconds to minutes under typical conditions of use, given the confines of the current workstation and the employee's proximity to the lamp.

While the symptoms and signs reported by the employees are consistent with UV-C overexposures, it is possible that there was some contribution to the overall UVR exposure from the UV-A tube. However, under typical conditions of use and in the absence of other predisposing conditions, the UV-A tubes alone would not be expected to result in the signs and symptoms reported by these employees.

The INS Safety Manager indicated that there have been no further reports of eye or skin problems since the UV-C tubes were removed in July 2001. In addition, we learned that the UV lamp has since been mounted underneath the workstation ledge so that it shines directly on the surface below, rather than directly at the employees, further reducing potential UV-A exposures.

## CONCLUSIONS

The environmental measurements indicate that the UV lamps used by INS Inspectors at the San Diego International Airport in March 2001 emitted high levels of UV-C radiation, representing a health hazard to those with close and direct contact with the lamps. The symptoms and signs reported by INS Inspectors are consistent with occupationally-induced photokeratitis and conjunctivitis due to UV-C overexposure.

Because the UV-C tubes are not needed for document verification, they should not be used for this task. UV-A tubes are appropriate for use in UV lamps for document verification.

## RECOMMENDATIONS

To prevent future problems resulting from the use of UV lamps for document verification, the following recommendations are offered:

1. Continue to use only the long wavelength UV-A tubes for document verification. When replacing the tubes or entire lamp assemblies, verify the UV-A output of the lamp "as assembled." The manufacturer should provide the measured UV-A output at a specified distance from the lamp (e.g., 10 inches). This value should be compared with the recommended occupational exposure limits to ensure that the workers will not be overexposed to UV-A at distances encountered during the performance of typical work tasks.

2. Mounting the lamps under the workstation ledge should serve to further reduce potential UV-A exposures to the workers' eyes and skin provided that UV-reflecting materials are not placed directly in the area where the lamps shine. In addition, workers who are sensitive to UVR, persons taking photosensitizing medications, those who lack optic lenses, or who have other abnormal eye conditions may not be adequately protected using the usual measures and should avoid exposure to artificial sources of UVR and discuss concerns with their personal physician. For some employees, the use of eye protection, tight-weave clothing, and UV-A

blocking sunscreen may provide sufficient protection during the period of time that they have increased sensitivity to UVR.

3. A medical surveillance program of employees using UVR should be instituted. Medical surveillance of workers potentially exposed to UVR should include a review of the workers' past medical histories to reveal any condition that is exacerbated or aggravated by exposure to UV radiation. The use of any drugs or medications by workers that may cause hypersensitivity to UV radiation also should be considered. Workers should be informed that any suspicious lesion that appears on skin exposed to UV should be examined by a physician.

4. Training and education should be provided to all workers potentially exposed to UV radiation. The training should include information on the hazards resulting from exposure to artificial sources of UV-A radiation, including conditions, medications, or other substances that may result in increased sensitivity to UVR, and procedures established to protect workers against those hazards. Workers should be told not to look directly into the UV lamp, to limit the duration of skin exposure as much as possible to a few seconds, and not to remove protective covers on the UV lamps or reposition the lamp in any way. If the lamp becomes damaged, it should not be used until it has been repaired.

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**Table 1**  
**Measured UV-C irradiance levels at Inspection Booth 2**  
**with only UV-C tube operating**  
**Immigration and Naturalization Service**  
**San Diego, California**  
**August 6, 2001**

Height Above Floor (inches)	Vertical Distance From Lamp (inches)	Range of Irradiance Levels ( $\mu\text{W}/\text{cm}^2$ )*	Permissible Exposure Time (PET) <sup>†</sup>
40	8	over range	N/A
40	10	465+	< 13 seconds
40	12	410–450+	< 13 seconds
40	18	330–404	15–18 seconds
40	57 (at edge of cubicle)	180–210	5 minutes
56	18	4.6–5.6	18–22 minutes

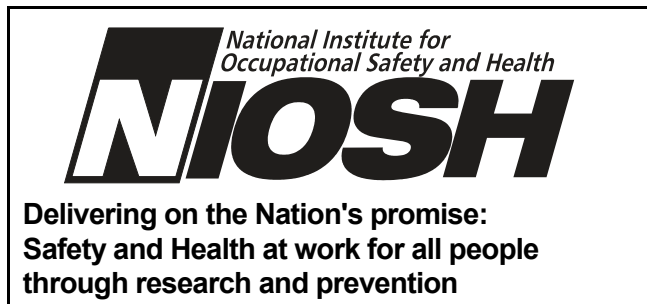
\*A range of irradiance levels is reported for three measurements made approximately 4" apart. Values with a "+" include those where at least one measurement was outside the range of the detector.

<sup>†</sup>The permissible exposure time is for exposure to UV radiation at 254 nm incident upon the unprotected skin or eye.

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