

6260
19 Sep 17

MEMORANDUM

From: Monterey Area Industrial Hygienist

To: Occupational Safety, Health, and Environmental Director, Naval Postgraduate School

Subj: PERIODIC INDUSTRIAL HYGIENE SURVEY

Ref: (a) OPNAVINST 5100.23G, Chapter 8, Appendix 8-B
(b) BUMEDINST 5100.13E, BUMED-M44, para (4)(f)4

Encl: (1) Industrial Hygiene Survey Report 62271-17-9

1. As required by reference (a), I conducted a two-year industrial hygiene survey of the Naval Postgraduate School, Monterey CRUSER Program's Robodojo Lab from 11 to 19 September 2017.
2. The signed formal report's issue has been delayed due to a number of factors. Enclosure (1) serves as an interim document until such time the formal report undergoes the required technical review required by reference (b) and is signed so it can be issued to your command.
3. If further consultation in regards to the technical content of this report is needed, please contact me at (831) 656-1074 or by email sethurst@nps.edu.


S. E. THURSTON

Industrial Hygiene Survey
of
Naval Postgraduate School, Monterey
CRUSER Program
Robodojo Lab
Report 62271-17-9
11 to 18 September 2017

Survey Conducted by: S. Eric Thurston, Industrial Hygienist

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Report 62271-17-9
EXECUTIVE SUMMARY

The 2017 Naval Postgraduate School, Monterey, CRUSER Program's Robodojo Lab (two-year) Periodic Industrial Hygiene Survey (PIHS) was recently conducted to assess the occupational health portion of its NAVHOSH program. Survey highlights are as follows:

- Since access to the Lab spaces isn't controlled, it's possible that unauthorized chemical products can be introduced/used and thus compliance with Hazardous Materials Control Program requirements may or may not be achieved. Recommendations to control access to the Lab and to obtain a lockable storage locker to limit access to, and prevent introduction of unauthorized, chemical products within the locker are made to better ensure compliance with program requirements.
- The Industrial Hygienist wasn't notified of the introduction of potentially noise-hazardous equipment into the space since the previous survey to allow noise measurements to occur. Noise measurements of the equipment not listed in Appendix C of this report need to be scheduled to allow any hearing protection requirements to be identified.
- Since the population of Lab users can vary widely, logs to document chemical products use and operation of identified noise-hazardous equipment are recommended so usage information needed to perform some of the required industrial hygiene chemical and noise exposure assessments is available.
- The Industrial Hygienist was not involved in the requested addition of methylene-containing acrylic cement to the Lab's Authorized Use List (AUL), and as a result was not aware of its presence until recent survey site visits. Apparently, the cement is still stored but not currently used. Because of the existence of a special Federal OSHA Methylene Chloride exposure standard, a qualitative exposure assessment of its use must be made to determine if expected exposure is significant or if a quantitative assessment achieved through air sampling is needed to make this determination. The Lab needs to contact the Industrial Hygienist prior to when the cement is to be used to allow the exposure assessment to be made, and whether or not any exposure controls are necessary for its use. This is a repeat Finding from the Lab's 2016 supplemental survey report, and since a response to the survey report was not received the Industrial Hygienist is unsure of the cement's current usage status.

**INDEX OF WORKPLACE EVALUATIONS
and
SURVEY SCHEDULE**

Two-year industrial hygiene surveys of academic labs with moderate health hazard potentials posed are warranted. The rest of the CRUSER Program work sites are under the custodianship of Naval Postgraduate School academic departments, and the processes performed are addressed as part of the surveys and reports for those departments. The only unique space solely under the CRUSER Program is the room that houses the Robodojo Lab, which is the only CRUSER Program function that needs to be periodically reviewed, per the below survey schedule:

Labs/Work Center	Survey Periodicity	Year Next Survey Due
Robodojo Lab	2-year	2019

Reference: OPNAVINST 5100.23G, Ch 8, Appendix 8-B

DISCUSSION, FINDINGS AND RECOMMENDATIONS

1. INTRODUCTION

As required by reference (a), Ch 8, a (two-year) Periodic Industrial Hygiene Survey (PIHS) of the Naval Postgraduate School, Monterey's CRUSER Program Robodojo Lab was conducted from 11 to 18 September 2017. The primary purpose of this survey was to identify and assess exposure to occupational hazards, review the occupational health portion of the NAVOSH program, and develop the required Exposure Monitoring Plan.

Reference: OPNAVINST 5100.23G, Ch 8, Appendix 8-B

The Robodojo Lab has a rather unique organizational structure:

- its Director is a Lecturer in the NPS Defense Analysis Department, but she is absent from day-to-day Lab operations.
- one day per week, an enlisted Sonar Technician assigned to the Systems Engineering Department is present in the Lab, but he only assists visitors using the space by:
 - operating the laser cutting machine to fabricate desired parts from stock material
 - providing guidance on operation of the Lab's 3-D printing machines if assistance is needed by the students
- The Lab can basically be used by anyone, gaining access through a key to the space obtained from the Director if she or the enlisted Sonar Technician are absent

2. PROGRAMS DISCUSSION:

a. ENGINEERING CONTROLS: Engineering controls used in this lab to reduce occupational health exposures include:

- use of temperature-controlled soldering irons during soldering to minimize the generation of airborne metal fumes.
- use of a filtering system housing both HEPA and carbon bed filters that is attached to the Robodojo Lab's laser cutting machine to reduce the levels of contaminants present in the machine's interior air that is recirculated back into the room.

b. HAZARDOUS MATERIAL CONTROL PROGRAM:

The Director and enlisted Sonar Technician do not perform processes involving chemical products. During past surveys (conducted as part of the NPS Systems Engineering Department that the space is assigned under until learning very recently that the Lab's is organized under the CRUSER Program), the Industrial Hygienist has noted that chemical products are kept in a small hazardous materials locker located in the larger outer room. Over the course of those previous surveys and the current one, different chemical products have appeared; however, the identity of the product user(s), and the processes that involve their use cannot be identified.

b. HAZARDOUS MATERIAL CONTROL PROGRAM (continued):

FINDING 62271-17-9-1:

- A chemical product inventory list is kept on top of the Lab's chemical storage locker, but its accuracy over time could not be determined.
- Theoretically anyone having access to the Lab can bring with them chemical products from other NPS departments or possibly purchased through outside sources using personal funds, making the certainty of their use approval through the required chemical product review and approval impossible to determine. It is likewise difficult to assess whether or not the hazardous materials authorization use (AUL) and inventory lists accurately reflect what chemical products are present in the Lab or if Safety Data Sheets (SDS's) are available for all chemical products present.
- Because anyone having access to the Lab can use any chemical products present or those brought into the space with them, required chemical use exposure assessments cannot be conducted due to lack of vital knowledge involving, e.g., frequency and duration of use, usage rates, exact processes involving their usage, since identities of users are unknown and can vary over time.
- Because the identity of the chemical products users is impossible, whether product users receive adequate hazardous communication training cannot be determined.

RECOMMENDATION 62271-17-9-1: The Industrial Hygienist is not confident that program requirement compliance is achievable through an openly accessible La, and proposes that:

- Access to the Lab be more tightly controlled to ensure that chemical product use complies with program requirements. Anyone cannot enter and use any of the machine tools or chemical products present in the Physics Department's Student Machine and Wood Shops until the department's Machinist/Model Maker provides training on proper equipment operation, personal protective equipment (PPE) needed, and that required medical surveillance and training are completed, with their names added to a list of those authorized to use the facilities. The Robodojo Lab could consider adopting such a system to better ensure that compliance with program requirements is achieved.
- All chemical products currently present in the Lab need to be reviewed by the command Hazardous Materials Control and Management Coordinator (HMCMC) to ensure they are approved for use through the required AUL addition/review process, and that AUL, inventory and SDS requirements are met.
- Once the review of all chemical products present occurs, a lockable hazardous materials locker(s) needs to replace the one currently present. It needs to remain locked and only unlocked by the person admitting visitors to the space to minimize the possibility that unauthorized products are not brought into the Lab.
- Since there aren't any Lab users who are present in the space regularly, a log needs to be established to document use of chemical products to include the usage date, approximate amount of time used, and approximate amount of product used each time. The log can then be reviewed by the Industrial Hygienist during the survey process so that information for exposure assessments is available, and any corrective actions needed to control exposures can be made and identified through the survey report.

References: OPNAVINST 5100.23G, Ch 7, paras 0702g(2),(3),(4),(6) and (9)(b); Ch 8, para 0802

b. HAZARDOUS MATERIAL CONTROL AND MANAGEMENT PROGRAM

(continued):

FINDING 62271-17-9-2: During the last two surveys of the Robodojo Lab, a methylene chloride-containing acrylic cement has been present, presumably to bond acrylic sheets cut by the Lab's Laser Cutting Machine. Methylene chloride is a highly toxic chemical with its own special Federal OSHA Standard that includes many requirements intended to prevent significant exposure from occurring. Although approved by the command's HMCMC, the Industrial Hygienist was not involved in the AUL addition process to allow him to use information both appearing on the AUL Addition Request Form and to be obtained from Lab staff to enable the required initial methylene chloride exposure determination.

RECOMMENDATION 62271-17-9-2: Apparently the cement is not currently being used, and as discussed above the identity of any users likely won't be possible. Contact the Industrial Hygienist to conduct an initial exposure determination prior to the cement's usage through exposure calculations. Critical information including daily cement usage rate and identification of space it is used in to allow room volume to be determined is needed to allow exposure calculations; if calculations do not result in a negative exposure assessment being made, air sampling of at least two jobs involving the cement's use on different days will be required, with results being used to determine if and the type of exposure controls needed. The Industrial Hygienist wasn't contacted since the Lab's 2016 supplement survey report to provide status of the cement usage.

Reference: 29 CFR 1910.1052, para (d)(2)

c. HEARING CONSERVATION PROGRAM:

Noise-hazardous sources generating levels between 85 and 96 dBA require the use of ear plugs or muffs (single hearing protection, SHP), while both plugs and muffs (double hearing protection, DHP) must be worn during operation of equipment generating levels at or above 96 dBA. Identified noise hazardous equipment in this Lab is limited to a 5-gallon Shop Vac wet-dry vacuum that is very occasionally used by the enlisted Sonar Technician. Since the calculated 8-hour average noise exposure from the Technician's use is insignificant, his enrollment in the Hearing Conservation Program, which includes hearing and audiograms (hearing tests) is not required, but operators must wear ear plugs or muffs and complete annual Personal Protective Equipment (PPE) training.

The measured noise levels of the Lab's Laser Cutting Room's Laser Cutting Machine/Laser Filter Exhaust System and cordless Dewalt hand drills, the latter occasionally used by the enlisted Sonar Technician, are below the Navy criterion level, and corrective action during their operation, including use of hearing protection, are unnecessary.

References: BUMEDNOTE 6260 M-44 of 9 May 16, enclosure (1), paras 5 and 6c
OPNAVINST 5100.23G, Ch 18, para 1807; Ch 20, para 2013

Historical measured noise levels, including those for the equipment discussed above, are summarized in Appendix C of this report.

c. HEARING CONSERVATION PROGRAM (continued):

FINDING 62271-17-9-3: Since the previous survey, the Industrial Hygienist noted the addition of several additional powered hand tools such as saws and drills that are stored in the outer room, again for the use of anyone having access to the Lab, but not by the enlisted Sonar Technician. The new ones may have been purchased by the Navy Foundation for stocking in the Lab; the command's Occupational Safety, Health, and Environmental (OSHE) Director also became aware that soon a band saw will be added to the space. Regardless of the source, the Industrial Hygienist was not notified of acquisition of potentially noise-hazardous equipment to enable measurements of their noise levels to determine the possible need for:

- wearing of appropriate hearing protection
- hearing conservation training
- audiograms (hearing tests).

Just as with the chemical products stored in the Lab and inability to conduct chemical exposure assessments, the identity of powered hand tools users cannot be determined, especially since they were not being used during the survey site visit. As a result:

- information vital to exposure assessment, e.g., frequency and duration of their usage, type of stock material worked on with them, cannot be obtained
- scheduling of noise measurements with someone familiar with their correct operation to enable gaining of the above information is impossible.

RECOMMENDATION 62271-17-9-3:

- Noise measurements of the above equipment needs to be scheduled with the Industrial Hygienist by someone familiar with their use so they can be operated safely
- Since there aren't any Lab users who are present in the space regularly, a log needs to be established to document use of the powered equipment identified as noise-hazardous by the above measurements to include for each item the date of use and approximate amount of time used each time. The log can then be reviewed by the Industrial Hygienist during the survey process so that information for exposure assessments is available, and any need to annual hearing conservation training and audiograms (hearing tests) can be identified.

References: BUMEDNOTE 6260 M-44 of 9 May 16, enclosure (1), paras 5 and 6c
OPNAVINST 5100.23G, Ch 8, para 0802; Ch 18, Section 1804

d. NON-IONIZING RADIATION CONTROL PROGRAM: This program is well controlled and managed. Non-ionizing radiation exposure limited to that resulting from operation of a GCC Laserpro Spirit GLS Laser Cutting Machine's that has an integrated class 4 laser for cutting and class 2 laser for alignment. The eye's blink mechanism will provide adequate protection against accidental exposure to laser radiation generated by the machine's class 2 alignment laser. The hazard analysis of the machine's class 4 laser conducted by the NPS LSSO indicates that protective eyewear or other exposure controls are unnecessary since the machine lid's materials absorb laser radiation, reducing its hazard potential to class 1 status.

e. **LEAD CONTROL PROGRAM:** Soldering stations are present to be used with staged non-leaded solder, but, as mentioned in the hazardous materials control program discussion, it's possible that personnel using the space could bring solder with them to perform lead-tin soldering, a common electronics support process, that may be involved in the Lab's electronics integral to robotics. The Navy's extensive monitoring data base indicates insignificant airborne levels of lead are generated by soldering performed using temperature-controlled irons, and similar insignificant levels of airborne fumes of metals present in solders used during the process are expected. As a result, enrollment of personnel performing soldering in the Lead medical surveillance program is unnecessary, but completion of Lead Awareness training as outlined in Appendix H of this report would be required for anyone performing soldering with leaded solder. However, as with the hearing conservation and hazardous materials control programs, since the identity of anyone performing lead-tin soldering in the space is unknown, determination of possible leaded solder use and completion of the above training by those using it is impossible. Recommendations above made for full compliance with the hazardous materials control program requirements should also identify whether or not lead-tin solder is used in this space, and identify those performing lead-tin soldering and thus require this training.

Reference: OPNAVINST 5100.23G, Ch 21, paragraph 2106

f. **OCCUPATIONAL REPRODUCTIVE HAZARDS PROGRAM:** Reproductive hazards encountered during departmental processes include:

LOCATION	HAZARD/TYPE	PRODUCT/PROCESS	EXPOSURE ASSESSMENT
Laser Cutting Room	Noise: PF	Shop Vac vacuum	Negative-8-hour average exposure is insignificant
Laser Cutting Room	Noise: PF	Laser Cutting Machine and Filter Exhaust System	Negative- measured noise levels are insignificant

M = male hazard F = female hazard PF = pregnant females
D = developmental hazard (hazard to the fetus)

Female (military) students performing any of the above processes involving female, developmental, or pregnant female hazards must inform their supervisor as soon as possible that they are pregnant. They and their supervisor must then complete the Developmental Hazard Worker's and Supervisor's Statement Forms. The student then must be scheduled for an appointment with an Occupational Health Physician, during which the forms need to be submitted and reviewed. All guidance provided by this process must be followed, and pregnant women should avoid or at least minimize work with the chemical products listed above that pose potential female, pregnant female, or developmental hazards, as well as avoid or at least minimize exposure while present during noise hazardous processes.

References: OPNAVINST 6000.1C, para 101e(3), Appendix B, and Appendix C
NMCPHC Technical Manual NMCPHC-TM-OEM 6260.01C, Section XII
OPNAVINST 5100.23G, Ch 29, Para 2903d(3)

g. RESPIRATORY PROTECTION PROGRAM: Operations requiring the use of respirators are not performed in this department, and none were found in Lab space to indicate that they are voluntarily worn.

h. PERSONAL PROTECTIVE EQUIPMENT(PPE): PPE reviewed were in satisfactory condition and properly stored. PPE listed in the below table is recommended for protection against potential health hazards associated with the listed processes, with required hearing protection discussed in the report’s Hearing Conservation Program section above:

LOCATION	PROCESS	RECOMMENDED PPE
Bldg 233, Room 221, Laser Lab	Class 3B and 4 lasers	Laser goggles

i. ERGONOMICS: There is no evidence that repetitive tasks or heavy lifting that would pose potential ergonomic hazards are performed in this Lab.

j. EXPOSURE-BASED MEDICAL SURVEILLANCE: Refer to Appendix F, the Exposure-Based Medical Surveillance Matrix based on industrial hygiene exposure assessments conducted as part of the survey process, for a full discussion of this program.

k. EXPOSURE-BASED TRAINING: See Appendix G for the Training Matrix also based on industrial hygiene exposure assessments conducted as part of the survey process.

3. OTHER CONSIDERATIONS

a. CHANGE OF OPERATION NOTIFICATION: The routine industrial hygiene survey process evaluates potential hazards to employees based on existing operations at the time of the survey. The command receiving services is responsible for notifying the local Industrial Hygiene Office of any changes in/new operations that could alter/introduce health hazards and exposures involved so that the new conditions and resulting exposures can be properly evaluated. Examples of changes that the Industrial Hygienist needs to be notified of include the following:

- new operations with suspected health hazards are performed
- new chemical products are used
- an increase in major chemical usage
- new equipment with potential noise hazards is used
- other new equipment posing suspected or known health hazards, such as lasers, is used
- exposure frequency and time changes of operations with potential or known health hazards
- a change in local exhaust ventilation systems

Reference: OPNAVINST 5100.23G, Ch 8, Para 0802g

b. SUMMARY OF SPECIAL INDUSTRIAL HYGIENE SURVEYS: There weren’t any special industrial hygiene surveys requested by or provided to the department since the previous two-year survey.

c. INDUSTRIAL HYGIENE REVIEWS: The Lab is requested to invite the Industrial Hygienist to participate in the review of SOPs, purchasing transactions, and contracts that may involve exposure to potential workplace health hazards.

Reference: OPNAVINST 5100.23G, Ch 5, Para 0503b

APPENDIX A

IH EXPOSURE ASSESSMENT/MONITORING PLAN		
WORKPLACE INFORMATION		
Organization: Naval Postgraduate School	Dept: Systems Engineering	Room Description: Robodojo Lab
Location: Bldg 235, Room 125A	Laboratory Director: Kristen Tsolis, POC: STG3 Samuel Zieglmeier	Phone: 831-656-7604, 831-656-2682
Workers: 2 faculty, 1 staff	Male: 1 faculty, 1 enlisted staff	Female: 1 faculty
<p>Operations: The number and sex of students and interns vary with time. The Lab's philosophy is that it can be used by any member of the Naval Postgraduate School, Naval Support Activity Monterey, or tenants.</p> <p>The following processes are performed by the Lab's Sonar Technician:</p> <ul style="list-style-type: none"> -A GCC Laserpro Spirit GLS laser cutting machine, which has an internal class 4 cutting laser and class 2 alignment laser, is programmed by the Lab's Sonar Technician and then cuts wood, acrylic and foam core board stock unattended, with cardboard used for cutting practice, and frosts but doesn't cut glass stock. The cutting machine is connected via ducting to a CSA600 Laser Filter Exhaust System, equipped with a HEPA filter for dust collection and an activated charcoal Deepbed Odor filter to allow recirculation of the filtered air from the machine's interior into the room, and a Magnehelic gauge, beeper, and red light to indicate when the filters needs to be changed out. -Very rare, occasional, and brief drilling using Dewalt cordless hand drills for a variety of purposes, including driving/undriving of screws and bolts. -Cleaning the Laser Cutting Room floor with a 5-gallon Shop Vac vacuum. <p>The following equipment/products are present, and exposure assessment can be made without detailed knowledge of usage:</p> <ul style="list-style-type: none"> -Two Ultimaker 2 3-D printers using plastic media are programmed with a computer and then print unattended. ABS plastic and CPE media are staged, but never used since their non-toxic odor is unpleasant to personnel present in the Lab. Software for printing is placed on SD cards by any qualified member on base and brought to the Lab, inserted, and then the machine is left unattended to print. -Several soldering stations and non-lead (tin/copper) solder. -A corded heat gun for application of shrink wrap on electrical wiring. <p>The following equipment/products are present, but status of use, frequency/duration of usage, and for powered hand tools the measured noise levels are unavailable due to never being operated or new since the previous survey and lack of operation during the current survey site visit, preventing the Industrial Hygienist from making exposure assessments:</p> <ul style="list-style-type: none"> -A portable 200 psig air compressor for powering of remotely located equipment. -A corded glue gun using Surebonder All Purpose Stik mini glue sticks. -Two-part JB Weld Steel Reinforced Epoxy reported to be used once in the past during fabrication of model rockets in the Lab, but not since that time; however current or planned future usage is indeterminate. -Sci Comp Acrylic Cement (containing +methylene chloride), presumably for bonding of acrylic stock. -1-pint metal containers of two-part epoxy. -Two benchtop mini-milling machines to cut aluminum, thicker wood, and PVC stock. -Several cordless and corded powered hand tools, including circular and reciprocating saws. 		
+ = carcinogen		

IH EXPOSURE ASSESSMENT/MONITORING PLAN (continued)

WORKPLACE INFORMATION

Organization: Naval Postgraduate School		Dept: Systems Engineering	Room: Robodojo Lab	
WORK TASK	POTENTIAL HAZARD	WORKERS INVOLVED	FREQUENCY/DURATION	MONITORING RECOMMENDED?
Laser cutting	Laser radiation, chemicals	1	Daily, 2 hours	No-Physical Agent
Cordless drills	*Noise, metal dust	1	Very rare, < 5 minutes	No-EA Noise, Chem
Vacuuming	*Noise	1	Once/2 wks, 10 minutes	No-EA Noise

IH EXPOSURE ASSESSMENT (EA)

***NOISE:**

Noise exposures resulting from use of the equipment listed/processes below fall under the “acceptable” exposure category defined by the Navy IHFOM, Chapter 4, paragraph 4.d(5)(c)(3) due to the negative exposure assessment rationales provided:

-The measured noise levels of the following equipment are below the Navy criterion level of 85 dBA:

- Dewalt cordless hand drills
- Laser Cutting Machine//Laser Filter Exhaust System

-The calculated 8-hour TWA exposure from use of the 5-gallon Shop Vac vacuum is below the NOEL of 85 dBA based on its measured noise level and brief duration of use.

-The Industrial Hygienists’ measurement data base indicates that heat guns do not generate noise levels exceeding the Navy criterion level of 85 dBA.

CHEMICALS

Chemical exposures resulting from processes listed below fall under the “acceptable” exposure category defined by the Navy IHFOM, Chapter 4, paragraph 4.d(5)(c)(3) due to the negative exposure assessment rationales provided:

-The laser cutting machine is programmed, and then closed during cutting once the stock material has been added, with the enclosure preventing significant amounts of airborne dust being generated external to the machine; as a result, dust exposures are expected to be below the MSALs and OELs. The machine is connected via ducting to a CSA600 Laser Filter Exhaust System, which is equipped with a HEPA filter for dust collection and an activated charcoal Deepbed Odor filter to allow recirculation of the exhausted air back into the room by removing air contaminants created during its operation. The CSA600 unit is equipped with a Magnehelic gauge to indicate when the filter needs to be changed out. It is also a largely unattended process, which further reduces the operator’s potential exposures to airborne chemicals generated during its operation.

-*Lead and tin fume exposures in the Electrical Integration & Assembly Lab during *lead-tin soldering are unlikely to exceed the AL and PEL for lead, and the MSAL and OEL for tin, based on monitoring data of similar operations performed elsewhere and use of-temperature-controlled soldering irons (which limit generation of lead fumes). Similar insignificant levels of airborne metals comprising the ingredients of non-lead solder are expected.

-The largely unattended 3-D printer process and use of non-toxic plastic that does not generate hazardous fabrication by-products is not expected to generate chemical vapor exposures above their MSALs and OELs.

+ = reproductive hazard

IH EXPOSURE ASSESSMENT/MONITORING PLAN (continued)

WORKPLACE INFORMATION

Organization: Naval Postgraduate School | **Dept:** Systems Engineering | **Room:** Robodojo Lab

IH EXPOSURE ASSESSMENT (EA) (continued)

LASER RADIATION:

Exposures resulting from use of the lasers listed/processes discussed below fall under the “acceptable” exposure category defined by the Navy IHFOM, Chapter 4, paragraph 4.d(5)(c)(3) due to the negative exposure assessment rationales provided:

Laser radiation levels during operation of the Laser Cutting Machine that per the LSSO’s evaluation will not exceed the TLVs based on the machine’s top plate glass being made of material that absorbs the class 4 laser’s radiation, reducing it to class 1 status, which does not present a hazard.

EXPOSURE CONTROL METHODS

PERSONAL PROTECTIVE EQUIPMENT (PPE): None at present.

ENGINEERING CONTROLS: The laser machine’s lid is made of material that absorbs the class 4 laser’s radiation.

RESPIRATORY PROTECTION PROGRAM: Respirators are not required during performance of the above processes, and there is no evidence they are worn voluntarily.

POTENTIAL HAZARD	NUMBER OF MEASUREMENTS	METHOD OF MEASUREMENT	FREQUENCY (per year)	MAN-HOURS (per year)
	None			

Use the following codes: not applicable

Signature: **Signed/** S. Eric Thurston, Industrial Hygienist | Date: 19 September 2017

APPENDIX B
PERSONAL STRESSOR EXPOSURE
SAMPLING RESULTS

Due to chemical exposure assessments not being currently possible, the need to conduct air sampling to quantify chemical exposure levels, or use of personal noise monitors to determine 8-hour TWA noise exposures, has not been identified.

**APPENDIX C
MEASURED EQUIPMENT
NOISE LEVELS**

<u>LOCATION</u>	<u>SOURCE</u>	<u>READING, dBA</u>	<u>HAZARD RADIUS, ft</u>
Robodojo	Dewalt cordless hand drill	84	N/A
Lab, Bldg	Laser Cutting Machine/Filter System	70	N/A
235, Room 125A	5-gallon Shop-Vac vacuum	88	4

**APPENDIX D
LOCAL EXHAUST
VENTILATION SYSTEM EVALUATION**

There aren't any local exhaust ventilation systems present in Lab spaces.

APPENDIX E
RESPIRATORY PROTECTION
PROGRAM MATRIX

Respirators are not required during performance of Lab processes and duties, and they aren't worn voluntarily.

**APPENDIX F
EXPOSURE-BASED
MEDICAL SURVEILLANCE MATRIX**

COMMAND: Naval Postgraduate School, Monterey
WORK CENTER: Robodojo Lab

DATE: August 2017

Department personnel do not require enrollment in medical surveillance programs based on industrial hygiene exposure assessments conducted as part of this survey.

Per CNO message R121344Z of July 2012 on medical surveillance, **the command rather than the Industrial Hygienist is responsible for determining if enrollment in occupation-based (Specialty/Certification) programs is necessary.** The Navy's medical surveillance manual was updated since the previous survey, with the most recent version being Edition 12 of August 2015 (updated 16 November 2016); instructions for accessing the manual online can be found at www.nmcphc.med.navy.mil, "Environmental Health" tab, "Occupational and Environmental Medicine" subtab, "Occupational and Environmental Medicine Division" link, "Technical Manuals and Guidance" link, and "Medical Surveillance Procedures Manual and Medical Matrix" link. The manual lists and discusses these Specialty programs and pertinent information about them in Chapter 13.

The exams can be scheduled with the Presidio of Monterey, Medical Clinic's Occupational Health Department. **Their policy is for the supervisor(s) to schedule exams rather than individual workers.**

**APPENDIX G
EXPOSURE-BASED
TRAINING MATRIX**

COMMAND: Naval Postgraduate School, Monterey
WORK CENTER: Robodojo Lab

DATE: August 2017

PROCESS	ESAMS TRAINING MODULE
Powered hand tools	PPE-Initial (1398), PPE-Job Specific (239)
Lead-tin soldering	Lead Awareness (322), Occupational Reproductive Awareness (1242), Reproductive Hazard Job Specific (197)
5-gallon Shop-Vac vacuum	PPE-Initial (1398), PPE-Job Specific (239)
Supervisors of Hazardous Materials Users	HAZCOM Training For Supervisors (1058)
Hazardous Materials Users	Basic HAZCOM Training (1169), HAZCOM Job/Chemical Specific (OJT-100)*

*Needs to be repeated whenever a new group of chemical product(s) is introduced for use into the work area.

All training is annual except as noted as Initial Only.

**APPENDIX H
GLOSSARY**

TERM	MEANING
AL	Action Level - Normally half of PEL. Exposure level at which air sampling, employee training, and medical surveillance are required.
ACGIH	American Conference of Government Industrial Hygienist
AC/HR	Air Changes Per Hour
ANSI	American National Standards Institute
AQS	Air Quality Standard
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
C	Ceiling - Toxic material exposure level which cannot be exceeded for any length of time.
cfm	Cubic Feet Per Minute
CFR	Code of Federal Regulation
DHP	Double hearing protection (both ear plugs and muffs)
EL	Excursion Limit - Concentration limit which cannot be exceeded at any time.
EAMP	Exposure Assessment/Monitoring Program. A program to evaluate workplace health hazards through surveys and exposure measurement.
EPA	Environmental Protection Agency
fc	Footcandles
fpm	Feet per minute
ft ³	Cubic feet
HEPA	High Efficiency Particulate Air
HM	Hazardous Material
HMC&M	Hazardous Material Control and Management
HW	Hazardous Waste
IES	Illumination Engineering Society
IH	Industrial Hygiene
L	Liter
Lpm	Liters Per Minute
LOD	Limit of Detection
LOQ	Limit of Quantification
mg/m ³	Milligrams per cubic meter of air. A means of expressing concentrations of dust and metal fumes in the air.
MSAL	Medical Surveillance Action Level. Concentration of air contaminant at which medical surveillance examinations must be provided to exposed personnel.
MSM	Medical Surveillance Matrix
NAVOSH	Navy Occupational Safety and Health
NEHC	Navy Environmental Health Center
NIOSH	National Institute of Occupational Safety and Health

APPENDIX H
GLOSSARY
(continued)

TERM	MEANING
OEL	Occupational Exposure Limit
OH/PM	Occupational Health/Preventive Medicine
OSHA	Occupational Safety and Health Administration
OV	Organic Vapor
PPE	Personal Protective Equipment
ppm	Parts per million. A means of expressing the concentration of gases and vapors in the air.
psi	Pounds per square inch
RFR	Radio Frequency Radiation
SDS	Safety Data Sheet. Formerly termed Material Safety Data Sheet (MSDS). A form used by manufacturers to communicate to users the chemical and physical properties of their products.
SHP	Single hearing protection (ear plugs or muffs)
SOP	Standard Operating Procedure
Sq ft	Square feet
STEL	Short Term Exposure Limit. A 15 minute time weighted average exposure which should not be exceeded at anytime during a workday.
Stressor	Potential hazard (e.g. Noise, Chemicals, Dusts, etc.)
TLV	Threshold Limit Value. Established by ACGIH as levels of airborne contaminants or physical hazards under which it is believed workers may be exposed on a daily basis without adverse effect.
TWA	Time Weighted Average. A method of averaging varying concentrations over a specified period of time, usually 8 hours.
ug	Microgram
VOL	Volume
>	Greater Than
<	Less Than