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
     (b) BUMEDINST 5100.13E, BUMED-M44, para (4)(f)(4)

Encl: (1) Industrial Hygiene Survey Report 62271-17-5

1. As required by reference (a), a two-year industrial hygiene survey of the joint Halligan Hall Machine Shop for the Naval Postgraduate School, Monterey’s, Mechanical/Aerospace Engineering Department and Space Systems Academic Group was conducted from 2 to 11 August 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 e-mail, sethurst@nps.edu.

[Signature]
S. E. THURSTON
Industrial Hygiene Survey
of
Naval Postgraduate School, Monterey
Halligan Hall Combined Machine Shop,
Mechanical/Aerospace Engineering Department
and Space Systems Academic Group
Report 62271-17-5
2 to 11 August 2017

Survey Conducted by: S. Eric Thurston, Industrial Hygienist
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The 2017 two-year industrial hygiene survey of the Naval Postgraduate School, Monterey’s combined Machine Shop for the Mechanical/Aerospace Engineering Department and Space Systems Academic Group was recently conducted to assess the occupational health portion of its NAVOSH Program.

There were no Findings. Recommendations are made to resolve performance problems with the Welding Room’s Fume Eliminator Machine, and to replace two chemical products containing methylene chloride, a highly toxic chemical with its own Federal OSHA regulatory standard, with specific products free of this chemical.

Monitoring to measure airborne metal fume exposures is needed during two jobs of each of the following processes, lasting of duration of at least 15 minutes, performed by the Space Systems Machinist/Model Maker:

- MIG welding aluminum
- plasma arc cutting aluminum
- plasma arc cutting mild steel
- plasma arc cutting stainless steel

The Industrial Hygienist needs to be contacted at least 48 hours in advance of these jobs to allow for preparation of needed sampling equipment and media, and to allow time for rescheduling of other normal duties if applicable.
### INDEX OF WORKPLACE EVALUATIONS and SURVEY SCHEDULE

<table>
<thead>
<tr>
<th>Work Center</th>
<th>Survey Periodicity</th>
<th>Year Next Survey Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE-SP Machine Shop</td>
<td>2-year</td>
<td>2019</td>
</tr>
</tbody>
</table>

Since moderate health hazard potentials are posed, two-year industrial hygiene surveys of this shop are warranted.

Reference: OPNAVINST 5100.23G, Ch 8, Appendix 8-B
DISCUSSION, FINDINGS AND RECOMMENDATIONS

1. INTRODUCTION

A two-year industrial hygiene survey of the Halligan Hall joint Machine Shop for the Naval Postgraduate School, Monterey’s Mechanical/Aerospace Engineering (MAE) Department and Space Systems (SP) Academic Group was conducted from 2 to 11 August 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 update the Exposure Monitoring Plan.

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

2. PROGRAMS REVIEW

a. ENGINEERING CONTROLS: The only engineering control present is the Fume Eliminator machines used during welding and cutting processes.

RECOMMENDATION 62271-17-5-1: A problem evidently still exists in that the Space Systems Machinist/Model Maker reported changing the Room 101C Fume Eliminator Machines filters and they are still not performing optimally. Just as with air-purifying respirators where cartridge changing may not resolve performance problems due to another factor, e.g., the exhalation valve base is cracked, filter changing may not resolve the problem. The manufacturer representative(s) need to be contacted to determine if further servicing and/or factory repair is needed. If this cost is prohibitive, consideration should be given to purchasing new units since they are 20 years old or older. The local Public Works Department addressed a problem with subpar performance of their Fume Eliminator Machine in this manner; the Monterey area Industrial Hygienist can upon request provide details concerning the machine to be purchased and the Public Works Department, Monterey Site Safety Manager’s contact information if discussion on this topic is desired on the specific machine selected for procurement.

b. RESPIRATORY PROTECTION PROGRAM: Personnel are not required to wear respirators during any operations performed in this shop. Voluntary wearing of 3M Model 8210 disposable respirators exists with the MAE Department’s Machinist/Model Maker during use of nontoxic Simple Green Cleaner, minor wood product fabrication, and handling of work with carbon fiber or fiberglass cloth, and rarely by the Space Systems Machinist/Model Maker, e.g., during removal of rust from older metal stock. Voluntary wearing of disposable respirators requires annual provision of Federal Respirator Standard Appendix D information. Ms. Michele Marnach, the command’s Respiratory Protection Program Manager (RPPM) discussed this topic during an early April 2017 departmental Safety Coordinator meeting to ensure dissemination to all command members. The Space Systems Machinist is up to date with annual receipt of this information, but due to Ms. Marnach’s emergency leave as the survey was ending, the MAE Department Machinist/Model Maker’s status of information receipt could not be determined.

References: OPNAVINST 5100.23G, Ch 15, paras 1503g, 1503g(1), and 1512 29 CFR 1910.134, Appendix D
c. HAZARDOUS MATERIAL CONTROL AND MANAGEMENT PROGRAM:

The command Safety Office’s Hazardous Materials Control and Management Coordinator (HMCMC) has developed a master AUL that includes the hazardous materials that the shop is authorized to store, use and procure. Any new products proposed for procurement requires submittal of the command’s AUL Request Form and the product’s SDS to the HMCM for the review process (including the Industrial Hygienist) prior to approval for addition to the AUL.

RECOMMENDATION 62271-17-5-2: The first and best control to reduce toxic material exposures is substitution with a less hazardous product. Although calculations indicate significant exposure to methylene chloride (a highly toxic chemical) is not expected during Thermacote Welco 1620 Anti-Spatter use by the Space Systems Machinist during MIG welding, substitution with another version free of this chemical is recommended since it:

- has very low permissible exposure standards
- is highly volatile (readily converts from liquid to airborne vapor)
- can cause serious health effects, and is a lung carcinogen (cancer-causing agent); some of these health effects can occur with prolonged and long-term skin contact.

As discussed during the previous survey report, the NPS HMCMC identified such a possible substitution product, CRC Chemical Company Welder’s Anti-Spatter 03083 (available through the Grainger Company) that contains only mildly toxic chemical ingredients and no methylene chloride. The shop should consider its procurement when the current Welco product is depleted.

Reference: OPNAVINST 5100.23G, Ch 5, para 0502a

RECOMMENDATION 62271-17-5-3: The MAE Department Machinist/Model Maker uses a mold release compound during small model fabrication using epoxy resins and cloth. In the past Buehler Mold Release Compound, whose old formulation that also contains methylene chloride as a major ingredient, was used for this purpose. Although air sampling during this compound’s use in the past by the MAE department’s Watkins Hall Lab spaces (indicates the absence of significant exposure, the first and best control to reduce toxic material exposures is substitution with a less hazardous product. Currently out of stock, the newer, non-aerosol can formulation of this mold release agent or Molykote 316 Silicone Mold Release Compound, both of which are free of methylene chloride as an ingredient, should be procured for this process.

Reference: OPNAVINST 5100.23G, Ch 5, para 0502a

Previous monitoring data collected during two consecutive days of use of Craftiks Acyrlic Liquid Solvent and IPS Weldon #16 Acrylic Cement by the MAE Department Machinist/Model Maker to bond acrylic sheets demonstrate that airborne methylene chloride concentrations are below all exposure standards. This data is summarized in Appendix B of this report.
d. **HEARING CONSERVATION PROGRAM**: Noise-hazardous shop equipment includes several machine tools, electric and pneumatic hand tools, vacuums, and compressed air nozzles. Calculated 8-hour average exposures from this equipment’s use are significant, and entry of both Machinist/Model Makers into the Command’s Hearing Conservation Program, with annual hearing tests (audiograms) and annual hearing conservation training, needs to continue. Ear plugs or muffs are required for noise levels between 85 and 96 dBA, and both plugs and muffs (double hearing protection) for noise levels at or above 96 dBA. Using this criteria, the following table summarizes hearing protection needed for equipment operation in this shop:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>REQUIRED HEARING PROTECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chicago 10-inch table saw</td>
<td>Ear plugs and muffs</td>
</tr>
<tr>
<td>• Dewalt cutoff saw</td>
<td></td>
</tr>
<tr>
<td>• Skil cored jig saw</td>
<td></td>
</tr>
<tr>
<td>• Bosch Bull Dawg hammer drill</td>
<td></td>
</tr>
<tr>
<td>• Dewalt cordless circular saw</td>
<td></td>
</tr>
<tr>
<td>• Dewalt cordless jig saw</td>
<td></td>
</tr>
<tr>
<td>• Dewalt cordless reciprocating saw</td>
<td></td>
</tr>
<tr>
<td>• Craftsman cored hand drill</td>
<td></td>
</tr>
<tr>
<td>• vertical disc sander portion of Wilton bench combination sanding unit</td>
<td></td>
</tr>
<tr>
<td>• Milwaukee rotary hammer, Baldor cutoff saw</td>
<td></td>
</tr>
<tr>
<td>• vertical disc sander portion of Delta combination sanding unit</td>
<td></td>
</tr>
<tr>
<td>• Milltronics CNC milling machine</td>
<td></td>
</tr>
<tr>
<td>• Delta horizontal belt/vertical disc sander</td>
<td></td>
</tr>
<tr>
<td>• Rockwell portable band saw</td>
<td></td>
</tr>
<tr>
<td>• Skil worm drive circular saw</td>
<td></td>
</tr>
<tr>
<td>• Bosch Yellow Jacket grinder</td>
<td></td>
</tr>
<tr>
<td>• Milwaukee portable drill press</td>
<td></td>
</tr>
<tr>
<td>• Bosch corded hand router</td>
<td></td>
</tr>
<tr>
<td>• vertical belt sander portion of Wilton bench combination sanding unit</td>
<td></td>
</tr>
<tr>
<td>• Dewalt corded swivel head shear</td>
<td></td>
</tr>
<tr>
<td>• pneumatic Dynafile</td>
<td></td>
</tr>
<tr>
<td>• compressed air nozzles</td>
<td></td>
</tr>
<tr>
<td>• wet-dry vacuums, powered hand drills except for the Craftsman unit above</td>
<td></td>
</tr>
<tr>
<td>• powered hand sanders/grinders</td>
<td></td>
</tr>
</tbody>
</table>
| • die grinders                                                           | Ear plugs or muffs
d. **HEARING CONSERVATION PROGRAM** (continued):

Currently, the following hearing protection is worn for these involved processes: Peltor Optime Model 101 (NRR = 26) or 105 (NRR = 30 dB) ear muff, and Howard Leight Fusion (NRR = 27) or EAR Classic (NRR = 29) disposable ear plugs.

e. **OCCUPATIONAL REPRODUCTIVE HAZARDS PROGRAM**: The following table lists reproductive hazards potentially encountered in this shop. Since there are no females that currently work in this shop, significant exposures that would pose actual hazards do not occur.

<table>
<thead>
<tr>
<th>HAZARD/TYPEx</th>
<th>PRODUCT/PROCESS</th>
<th>EXPOSURE ASSESSMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise: PF</td>
<td>Variety of machine tools and powered hand tools</td>
<td>Positive-calculated 8-hour noise exposure is significant</td>
</tr>
<tr>
<td>Xylenes: F, Toluene: D</td>
<td>Aerosol paint/primer cans</td>
<td>Negative-dilution with outdoor air, minimal usage</td>
</tr>
<tr>
<td>Alcohols: F</td>
<td>Chemical cleaning, use as aluminum stock machining lubricant</td>
<td>Negative-minimal usage</td>
</tr>
<tr>
<td>Xylenes, Alcohols: F</td>
<td>La-Co Markers</td>
<td>Negative-minimal usage</td>
</tr>
</tbody>
</table>

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

f. **EXPOSURE MONITORING**:

ACTION 62271-17-5-A: Monitoring to measure airborne metal fume exposures is needed during two jobs of each of the following processes, lasting of duration of at least 15 minutes, performed by the Space Systems Machinist/Model Maker:

- MIG welding aluminum
- plasma arc cutting aluminum
- plasma arc cutting mild steel
- plasma arc cutting stainless steel

The Industrial Hygienist needs to be contacted at least 48 hours in advance of these jobs at either sethurst@nps.edu or (831) 656-1074 to allow for preparation of needed sampling equipment and media, and to allow time for rescheduling of other normal duties if applicable.

**Reference**: OPNAVINST 5100.23G, Ch 8, para 0802e(1)

g. **ERGONOMICS**: Repetitive tasks are not performed in this department, and there have been no injuries related to ergonomic issues.
h. PERSONAL PROTECTIVE EQUIPMENT (PPE): All PPE observed during the survey were found to be clean, serviceable, and properly stored. PPE appearing on the following table is recommended for protection against the listed process potential health hazards:

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>HAZMAT/CHEMICAL PRODUCT</th>
<th>RECOMMENDED PPE (WITH GLOVE MATERIAL PROVIDING BEST PROTECTION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding/cutting</td>
<td>Welding electrodes</td>
<td>Welding helmet, leather gloves and jacket</td>
</tr>
<tr>
<td>Bonding acrylics</td>
<td>Crafticks Liquid Solvent, acrylic cement</td>
<td>Butyl rubber gloves</td>
</tr>
<tr>
<td>MIG welding</td>
<td>Thermacote Welco 1620 Anti-Spatter</td>
<td>Butyl rubber gloves</td>
</tr>
<tr>
<td>Handling other chemical products</td>
<td>Numerous other chemical products</td>
<td>Safety glasses, latex or butyl rubber gloves</td>
</tr>
</tbody>
</table>

i. CHEMICAL CARGINOGENS: Summary information concerning carcinogens encountered in the workplace appear in the following table:

<table>
<thead>
<tr>
<th>CARCINOGEN</th>
<th>SOURCE</th>
<th>LISTING ORGANIZATION(S) AND CLASSIFICATION(S)</th>
</tr>
</thead>
</table>

j. EXPOSURE-BASED MEDICAL SURVEILLANCE: See Appendix F for the Medical Surveillance Matrix based on industrial hygiene exposure assessments.

k. EXPOSURE-BASED TRAINING: See Appendix G for the Training Matrix based on assessments conducted by the Industrial Hygienist.

3. OTHER CONSIDERATIONS

a. SUMMARY OF SPECIAL INDUSTRIAL HYGIENE SURVEYS: The only special industrial hygiene survey requested by or provided to the Machine Shop since the previous two-year survey involved noise measurement of a replacement Makita angle grinder, which requires the same (single) hearing protection as the broken one it replaced.

b. INDUSTRIAL HYGIENE REVIEWS: The departments who employ the Machinist/Model Makers are 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
c. **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 to notify 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. A form to report such changes can be provided by contacting S. Eric Thurston, Industrial Hygienist, at sethurst@nps.edu. Once completed, the form needs to be forwarded to the Industrial Hygienist to enable a review of the change. 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
APPENDIX A

IH EXPOSURE ASSESSMENT/MONITORING PLAN

WORKPLACE INFORMATION

<table>
<thead>
<tr>
<th>Organization</th>
<th>Dept: MAE Department and SP Academic Group</th>
<th>Work Center: Combined Machine Shop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Naval Postgraduate School</td>
<td>Bldg 234, Rooms 100, 101C-H</td>
</tr>
<tr>
<td>POCs:</td>
<td>John Mobley, Levi Owen</td>
<td>Phone: 831-656-2425</td>
</tr>
<tr>
<td>Workers:</td>
<td>2 Machinists</td>
<td>Male: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female: 0</td>
</tr>
</tbody>
</table>

Operations: Prepares metal and non-metal items for student and research projects using a variety of machine and powered/pneumatic hand tools. Aluminum is the primary metal worked on, but minimal amounts of stainless steel, carbon steel, Inconel, and plastics may also be worked on. Room 100 machine tools present include grinding wheels, manual milling machines, lathes, drill presses, combination sanding units, a power hacksaw, CNC machines, a band saw, and four Haas machining centers. Other equipment used include a glass bead blasting cabinet, a variety of cordless and corded power hand tools, pneumatic hand tools, and a cutoff saw used for cutting metal or wood stock. Compressed air nozzles are used to remove loose debris from machine. A variety of machine oils/lubricants and cutting fluids, rarely kerosene, *isopropyl alcohol and kerosene (for aluminum stock), and WD-40 aerosol cans are used for lubrication of machine tools and parts.

- Very rarely and on an as-needed basis:
  - fabricates small wooden structures for internal use in the shop, e.g., structures for custom tool rests next to machine tools, with powered hand tools and wood stock
  - uses a corded hammer drill or rotary hammer to bolt equipment when moved to new locations into the cement shop floor
  - a pneumatic handheld needle scaler is used to remove oxides and other contaminants prior to welding.
  - Acetone, *isopropyl alcohol, and occasionally kerosene are used for general chemical cleaning, with kerosene also serving as a preserving agent for metal surfaces.
  - - A variety of epoxy resins bond project parts and surfaces.
  - Crafstick Plastick Acrylic Liquid Solvent and IPS Weldon #16 Acrylic Cement (with both products containing +methylene chloride as a major constituent) are used for bonding acrylic parts.
  - *Toluene- and *xylene-containing aerosol primer and paint cans are used for general outdoor touchup painting of a variety of items.
  - La-Co markers, containing inks with *xylenes and *alcohols as chemical ingredients, are mainly used for marking metal surfaces.
  - Small model fabrication using epoxy resins and either fiberglass or carbon fiber cloth occurs rarely. The cloth is manually cut with hand scissors, and the resins are applied to it by hand. Silicone mold release compound is applied via an aerosol can prior to laying up of the resin-impregnated cloth over mold template surfaces to ease removal when the resin is dry. When dry, the edges are smoothed by manual hand sanding with sandpaper.
  - Because of the presence of sprayed-on asbestos in the overhead of Welding Room 101C, the following jobs are temporarily performed at the MAE Department’s Bldg 214 Welding Area:
  1. The Space Systems Machinist teaches students shielded metal arc (SMA) welding techniques on mild steel in support of thesis project fabrication and general engineering classes, with TIG welding of aluminum and mild steel currently limited to one-time student demonstrations.

* = reproductive hazard  + = carcinogen
## IH EXPOSURE ASSESSMENT/MONITORING PLAN

### WORKPLACE INFORMATION

**Organization**: Naval Postgraduate School  
**Dept**: MAE Dept/SP Academic Group  
**Work Center**: Bldg 234 Combined Machine Shop

### Operations (continued):

- MIG welding on mild steel and aluminum
- Plasma arc cutting on mild steel, aluminum and stainless steel
- SMA welding on mild steel
- Oxy-acetylene cutting on mild steel
- TIG welding on stainless steel and aluminum
- Silver soldering aluminum, and carbon and stainless steels, using Uniweld UNI-1056FC rods
- Torch soldering on copper using spool of (thick) *lead solder.

<table>
<thead>
<tr>
<th>WORK TASK</th>
<th>POTENTIAL HAZARD</th>
<th>WORKERS INVOLVED</th>
<th>FREQUENCY/ DURATION</th>
<th>MONITORING RECOMMENDED?</th>
</tr>
</thead>
<tbody>
<tr>
<td>M,E,P tools</td>
<td>*Noise, metal dust</td>
<td>2</td>
<td>Daily, up to 8 hrs</td>
<td>No-EA Noise, Chem</td>
</tr>
<tr>
<td>Bead blasting</td>
<td>*Noise, dusts</td>
<td>2</td>
<td>Twice/wk, 20 mins</td>
<td>No-EA Noise, Chem</td>
</tr>
<tr>
<td>Oils, lubricants</td>
<td>Petroleum dists, oil</td>
<td>2</td>
<td>32 ozs; 2 liters/yr</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Solvents use</td>
<td>Acetone, *alcohols</td>
<td>1</td>
<td>1 quart/month</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Kerosene use</td>
<td>Petroleum distillates</td>
<td>1</td>
<td>1 quart/month</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Dewalt Cutoff Saw</td>
<td>*Noise, dusts</td>
<td>2</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Makita Disc Sander</td>
<td>*Noise, wood dust</td>
<td>2</td>
<td>Rare, 30 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Dewalt Circular Saw</td>
<td>*Noise, wood dust</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Dewalt Jig Saw</td>
<td>*Noise, wood dust</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Skil Jig Saw</td>
<td>*Noise, wood dust</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Dewalt Recipctng Saw</td>
<td>*Noise, wood dust</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Wilton vert disc sandr</td>
<td>*Noise, dusts</td>
<td>1</td>
<td>3 times/wk,5 mins</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Wood fabrication</td>
<td>*Noise, wood dust</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Bosch hammer drill</td>
<td>*Noise, dusts</td>
<td>2</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Milwk rotary hammer</td>
<td>*Noise, dusts</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Needle scaler</td>
<td>*Noise, dusts</td>
<td>1</td>
<td>Rare, 5 minutes</td>
<td>No-EA Noise,Chem</td>
</tr>
<tr>
<td>Epoxo resins</td>
<td>Epichlorhydrin, solvents</td>
<td>2</td>
<td>2 ounces/year</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Crafticks Liqd Solvnt</td>
<td>+Methylene Chloride</td>
<td>1</td>
<td>Rare, 2 ounces/time</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Acrylic cement</td>
<td>+Methylene Chloride</td>
<td>1</td>
<td>Rare, 2 ounces/time</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Aerosol paint</td>
<td>*Tolne,*xylene, slvnts</td>
<td>2</td>
<td>AN few ozs/day</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>La-Co markers</td>
<td>*Alcohols, *xylenes</td>
<td>1</td>
<td>4 ounces/2 yrs</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Composite resin/cloth</td>
<td>MMVF, styrene,</td>
<td>1</td>
<td>AN, 1 hr/day</td>
<td>No-see EA</td>
</tr>
<tr>
<td>layup/sanding</td>
<td>amines, other solvents</td>
<td></td>
<td></td>
<td>Chemical</td>
</tr>
<tr>
<td>Mold Release Cmpnd</td>
<td>Slvnts, possible+MeCl</td>
<td>1</td>
<td>Rare, 2 ozs/time</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Welding</td>
<td>FeO3,Ni,Cr,Al fumes</td>
<td>1</td>
<td>10 times/yr, 2 hrs</td>
<td>Yes-see EA Chem</td>
</tr>
<tr>
<td>Plasma arc cutting</td>
<td>FeO3,Ni,Cr,Al fumes</td>
<td>1</td>
<td>20Times/yr,20Mins</td>
<td>Yes-see EA Chem</td>
</tr>
<tr>
<td>Silver soldering</td>
<td>Cu,Ni,Ag,Sn,ZnOFumes</td>
<td>1</td>
<td>Once/year, 1 hour</td>
<td>No--see EA Chem</td>
</tr>
<tr>
<td>Welding class</td>
<td>Iron oxide fumes</td>
<td>2-4</td>
<td>6 times/qtrr,1hr/day</td>
<td>No-see EA Chem</td>
</tr>
<tr>
<td>Lead soldering</td>
<td>*Lead, copper fumes</td>
<td>1</td>
<td>Once/year, 2 mins</td>
<td>No-see EA Chem</td>
</tr>
</tbody>
</table>

* = reproductive hazard  
AN = as needed
**IH EXPOSURE ASSESSMENT/MONITORING PLAN**

**WORKPLACE INFORMATION**


**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.

- Measured noise levels of the following equipment are below the Navy criterion level of 85 dBA:
  - lathes
  - Crub band saw
  - power hacksaw
  - bead blasting cabinet
  - corded hand-held heat guns
  - electric rotary hand tool
  - Haas machinery centers

- The measured noise levels of similar equipment located at other commands indicate the levels of the dual benchtop wire/buffing wheels will be far below the Navy criterion level of 85 dBA.

Noise exposures during the process listed below fall under the “unacceptable” exposure category defined by the Navy IHFOM, Chapter 4, paragraph 4.d(5)(c)(3):

Calculated noise exposures during combined use of machine (M) tools, pneumatic (P) and electric (E) hand tools can exceed the NOEL based on measured noise levels and cumulative reported exposure durations.

**CHEMICALS**

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

Monitoring is needed to quantify exposures during:
- MIG welding of aluminum (aluminum)
- plasma arc cutting of:
  - mild steel (iron oxide fumes)
  - aluminum (aluminum)
  - stainless steel (iron oxide fumes, nickel, and chromium)

**CHEMICALS (continued)**

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

- Low speed machining generates metal chips and slivers, which are too heavy to become airborne.
- Low toxicity oils and lubricants are not expected to result in significant oil and related chemicals airborne exposures, and petroleum distillate exposures are expected to be below the MSAL and OEL, based on their overall low volatility and relatively high exposure standards.
- Intermittent, short duration use of saws, grinding wheels, sanders/grinders, needle scaler, hammer drill, or rotary hammer will not result in metal/wood dust exposures above the OELS or MSALs.

* = reproductive hazard
IH EXPOSURE ASSESSMENT/MONITORING PLAN

WORKPLACE INFORMATION


IH EXPOSURE ASSESSMENT (EA) (continued)

CHEMICALS (continued)

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

- Nuisance dust exposure during use of the bead blasting cabinet are expected to be below the OELs since the operator is isolated from the dust by the sealed cabinet that is equipped with an attached vacuum system to ease visibility, and there is no evidence of leakage of dust/glass bead blasting media outside the cabinet due to such factors as deteriorating cabinet seals.

- Minimal usage of the following are not expected to result in exposures above the MSALs and OELs:
  - acetone
  - *isopropyl alcohol
  - kerosene (petroleum distillates exposure)
  - epoxy resins (epichlorohydrin and other solvent exposures)

- Monitoring data of 1 and 2 April 2010 indicates that +methylene chloride exposure from use of both Craftics Plastick Acrylic Liquid Solvent and Weldon 16 Acrylic Cement to bond acrylic parts is below the AL, PEL and STEL.

- *Toluene, *xylene, *alcohols, and other solvent exposures during use of aerosol paint cans or La-Co markers are expected to be below the MSALs and OELs based on minimal usage and dilution with outdoor air.

- Composite cloth cutting with hand scissors and finished models hand sanding are not expected to result in MMVF (manmade vitreous fiber) exposures above the MSALs and OELs since a minimal amount of airborne dust is inherently generated. Minimal usage of chemical resins during composite layup is not expected to generate styrene, amines, and other solvent exposures above the MSALs and OELs.

- Monitoring data collected during use of an aerosol can of the older formulation of Buehler Mold Release Compound in an MAE Department Lab during a similar application environment indicated that no measurable levels of +methylene chloride were generated, and similar exposure levels are expected at this location. More current formulation is free of methylene chloride and only mildly toxic solvents, whose exposure are expected to be below the MSALs and OELs based on very minimal usage.

- Previous monitoring data collected on 18 April 2001 during SMA welding of carbon steel base metal in Room 101C, and on 6 September 2002 during SMA welding and oxy-acetylene cutting of mild steel stock in the Monterey Public Works Bldg 427 Welding Area, while using similar Fume Eliminator Machines indicates iron oxide fume exposures were below the MSALs and OELs; similar levels are expected during SMA welding of mild steel base metal performed at the Bldg 214 location.

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

From the below, significant aluminum, iron oxide, nickel, and chromium 8-hour exposures during the Space Systems Machinist’s aluminum and stainless steel TIG welding processes are not expected based historical monitoring data of TIG welding processes involving:

- **aluminum** base metal during:
  - three operations performed at Mare Island Naval Shipyard (documented in the 1982 industrial hygiene welding processes survey report’s monitoring data base) generated instantaneous aluminum air sample levels (performed with local exhaust ventilation (LEV, that will provide the same capture velocity as a Fume Eliminator Machine) that were below detectable limits, or 5 or 10 times below the TLV and 2.5 or 5 times below the MSAL
  - a SIMA San Francisco operation, traceable to Alameda Industrial Hygiene Office Survey NF-1010, generated instantaneous aluminum air sample levels that were approximately 16 times below the TLV and 8 times below the MSAL. Note that calculated 8-hour average exposures were much lower since the jobs were an hour or two in length.

- **stainless steel** base metal during
  - three operations performed (with local exhaust ventilation (LEV) that will provide the same capture velocity as a Fume Eliminator Machine) at Mare Island Naval Shipyard (documented in the 1982 industrial hygiene welding processes survey report’s monitoring data base) generated instantaneous air sample levels of:
    - iron oxide fumes at least 250 times below the OEL and 125 times below the MSAL
    - nickel and chromium that were below detectable limits. Note that calculated 8-hour average exposures were much lower since the jobs were an hour or two in length.
  - SIMA San Francisco and Naval Aviation Depot, Alameda operations (of several hours length), traceable to Alameda IH Office Surveys NF-1010, -1045, and -2208, generated calculated 8-hour exposures of:
    - nickel ~ 20 to 1500 times below the TLV and ~ 10 to 750 times below the MSAL
    - chromium ~ 65 to 1500 times below the TLV and ~ 33 to 750 times below the MSAL
    - iron oxide fumes ~ 100 to 3500 times below the PEL and ~ 50 to 1,800 times below the MSAL.

Five shipboard and two facility **MIG welding** processes performed on mild steel base metal with LEV (that will provide the same capture velocity as a Fume Eliminator Machine) at Mare Island Naval Shipyard from the 1982 industrial hygiene welding monitoring data base generated instantaneous air sample levels of **iron oxide fume** exposures that were at a minimum 25 times below the OEL and 12.5 times below the MSAL; since the jobs did not last the entire 8-hour work shift calculated 8-hour average exposures were much lower than these values. As a result, the Space Systems Machinist’s mild steel MIG welding processes are also not expected to generate significant iron oxide fumes exposures.
### IH EXPOSURE ASSESSMENT/MONITORING PLAN

#### WORKPLACE INFORMATION


#### IH EXPOSURE ASSESSMENT (EA) (continued)

**CHEMICALS (continued)**

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

- Monitoring of fifteen silver soldering processes, traceable to Alameda Industrial Hygiene Office Surveys NF-1337,-1347,-1451,-1496,-1500,-1793,-1872,-2123,-2157,-2218,-2265,-2317,-2391,-2431, and -2472 conducted at NAS and Naval Aviation Depot Alameda, and SIMA San Francisco, indicate that:
  - measured instantaneous air sample levels for copper fume ranged from below detectable limits to ~2.5 times below the PEL and ~1.25 below the MSAL
  - measured instantaneous air sample levels for zinc oxide fume ranged from below detectable limits to 150 times below the PEL and 75 times below the MSAL
  - for all but two jobs, 8-hour TWA exposures of silver ranged were below detectable limits while for two jobs the PEL was exceeded but were caused by unacceptable environmental conditions (the first a poorly designed local exhaust ventilation system and the second where a strong breeze that day coming from an adjacent large building open rollup door) that directed and concentrated airborne metal fumes into the brazers’ breathing zones).

Since environmental conditions in the latter two jobs are not present in the Space Systems Machinist’s work area, his copper fume, zinc oxide fume, and silver 8-hour average exposures are expected to be below the OELs and MSALs, with similar exposure expected for tin.

- Lead and copper fume exposures during soldering of copper base metal with heavy gauge lead solder are not expected to exceed the *lead AL and PEL, and copper fume MSAL and OEL based on very brief job duration.

#### EXPOSURE CONTROL METHODS

**ENGINEERING CONTROLS** (to control exposures to potential health hazards): Fume Eliminator machine during welding/cutting performed in the MAE Department Golf Course Annex Labs Bldg 214 Machine Shop welding area.

**PERSONAL PROTECTIVE EQUIPMENT (PPE)** (to control exposures to potential health hazards):

- Optime Model 101 ear muffs (NRR = 26), Howard Leight Fusion (NRR = 27) or EAR Classic (NRR = 29) disposable ear plugs. Appropriate use of single hearing protection (plugs or muffs) and double hearing protection (plugs and muffs) during noise-hazardous equipment operation.
- Welding helmet equipped with self-adjusting shade lens, and leather gloves and jacket, during welding.

**RESPIRATORY PROTECTION PROGRAM:** Not required during performance of the above operations. Voluntary use of 3M N95 Model 8210 disposable respirators:

- by the MAE Department Machinist/Model Maker during use of non-toxic Simple Green Cleaning Compound, manual cutting of carbon and fiberglass cloth using scissors, or manual sanding (with sandpaper) of small composite models
- rarely by the Space Systems Academic Group Machinist/Model Maker during such jobs as manual removal of rust from steel stock that causes slight levels of airborne iron oxide dust.
## IH EXPOSURE ASSESSMENT/MONITORING PLAN

### WORKPLACE INFORMATION


### MONITORING PLAN

<table>
<thead>
<tr>
<th>POTENTIAL HAZARD PROCESS</th>
<th>NUMBER OF MEASUREMENTS</th>
<th>METHOD OF MEASUREMENT</th>
<th>FREQUENCY (per year)</th>
<th>MAN-HOURS (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum, MIG welding</td>
<td>2</td>
<td>FI-MCEF</td>
<td>Twice</td>
<td>12</td>
</tr>
<tr>
<td>Iron oxide fumes, plasma arc cutting mild steel</td>
<td>2</td>
<td>FI-MCEF</td>
<td>Twice</td>
<td>12</td>
</tr>
<tr>
<td>Aluminum, plasma arc cutting aluminum</td>
<td>2</td>
<td>FI-MCEF</td>
<td>Twice</td>
<td>12</td>
</tr>
<tr>
<td>Iron oxide, nickel, chromium fumes, plasma arc cutting stainless steel</td>
<td>2</td>
<td>FI-MCEF</td>
<td>Twice</td>
<td>12</td>
</tr>
</tbody>
</table>

Use the following codes: FI-MCEF = 37 mm 0.8 micron MCEF filter

Signature: **Signed/** S. Eric Thurston, Industrial Hygienist  
Date: 11 August 2017
## APPENDIX B
### HISTORICAL AIR SAMPLING RESULTS

<table>
<thead>
<tr>
<th>DATE</th>
<th>JOB</th>
<th>STRESSOR</th>
<th>RESULTS</th>
<th>CRITERION</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Apr 01</td>
<td>Shielded metal arc welding</td>
<td>Iron Oxide Fumes</td>
<td>0.01 mg/m³</td>
<td>OEL = 10 mg/m³</td>
</tr>
<tr>
<td>1 Apr 10</td>
<td>Acrylic sheet bonding</td>
<td>Methylene chloride</td>
<td>TWA = 0.610 ppm</td>
<td>PEL = 25 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>STE = 34.0 ppm</td>
<td>STEL = 125 ppm</td>
</tr>
<tr>
<td>2 Apr 10</td>
<td>“</td>
<td>Methylene chloride</td>
<td>TWA = 0.623 ppm</td>
<td>“</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>STE = 19.6 ppm</td>
<td></td>
</tr>
<tr>
<td>26 Nov 14</td>
<td>Epoxy floor coating application:</td>
<td>Xylenes</td>
<td>TWA = 0.665 ppm</td>
<td>OEL-TWA = 100 ppm</td>
</tr>
<tr>
<td></td>
<td>• Entire floor coating job</td>
<td></td>
<td>STE = LTD</td>
<td>OEL- STEL = 150 ppm</td>
</tr>
<tr>
<td></td>
<td>• Mixing</td>
<td></td>
<td>STE = 3.45 ppm</td>
<td>“</td>
</tr>
<tr>
<td></td>
<td>• Apply epoxy floor coating</td>
<td></td>
<td>“</td>
<td></td>
</tr>
</tbody>
</table>

mg/m³ = milligrams per cubic meter  
PEL = Permissible Exposure Limit  
TWA = Time-Weighted Average  
ppm = parts per million  
STE = Short Term Exposure  
STEL = Short Term Exposure Limit  
LTD = less than detectable  
OEL = Occupational Exposure Limit
# APPENDIX C
## MEASURED EQUIPMENT NOISE LEVELS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOURCE</th>
<th>READING</th>
<th>HAZARD RADIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bldg 234, Rooms 101 D-H</td>
<td>Hardinge Lathe</td>
<td>69 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Crob Band Saw</td>
<td>77 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Hem-Saw Power Hacksaw</td>
<td>72 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Abrasive Blasting Glovebox</td>
<td>82 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Delta Milwaukee Carbide Grinding Wheel</td>
<td>84 dBA</td>
<td>1 ft</td>
</tr>
<tr>
<td></td>
<td>Prosser Carbide Grinding Wheel</td>
<td>92 dBA</td>
<td>10 ft</td>
</tr>
<tr>
<td></td>
<td>Delta Grinding Wheel</td>
<td>93 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>Bridgeport Milling Machine #1</td>
<td>72 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>normal operation</td>
<td>72 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>mounted butterfly bar wrench in use</td>
<td>88 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Bridgeport Milling Machine #2</td>
<td>78 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>normal operation</td>
<td>78 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>mounted butterfly bar wrench in use</td>
<td>92 dBA</td>
<td>8 ft</td>
</tr>
<tr>
<td></td>
<td>Baldor Dual Wheel Grinder</td>
<td>78 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Chicago Electric 10-Inch Table Saw</td>
<td>97 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Milltronics VII CNC Mill Machine</td>
<td>85 dBA</td>
<td>1 ft</td>
</tr>
<tr>
<td></td>
<td>Haas TM-3P Milling Machine</td>
<td>79 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Dewalt Cutoff Saw</td>
<td>108 dBA</td>
<td>50 ft</td>
</tr>
<tr>
<td></td>
<td>Delta Combination Sanding Unit:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horizontal Belt Sander</td>
<td>92 dBA</td>
<td>10 ft</td>
</tr>
<tr>
<td></td>
<td>Vertical Disc Sander</td>
<td>85 dBA</td>
<td>3 ft</td>
</tr>
<tr>
<td></td>
<td>Compressed Air Nozzles</td>
<td>89-98 dBA</td>
<td>4 ft</td>
</tr>
<tr>
<td></td>
<td>Wet/Dry Vacuums</td>
<td>88-91 dBA</td>
<td>2 ft</td>
</tr>
<tr>
<td></td>
<td>Red Master Heat Gun</td>
<td>74 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Dewalt Heat Gun</td>
<td>64 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Rockwell Porta-Band Band Saw</td>
<td>87 dBA</td>
<td>4 ft</td>
</tr>
<tr>
<td></td>
<td>Skil Worm Drive Circular Saw</td>
<td>92 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Bosch Yellow Jacket Grinder</td>
<td>94 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Portable Drill Press</td>
<td>92 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Skil Corded Jig Saw</td>
<td>98 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Black &amp; Decker Variable Hand Drill</td>
<td>88 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Skil ¼ Inch Hand Drill</td>
<td>84 dBA</td>
<td>2 ft</td>
</tr>
<tr>
<td></td>
<td>Bosch Corded Hand Router</td>
<td>93 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>HIOS Corded Rotary Hand Tool</td>
<td>65 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Makita Corded Palm Sander</td>
<td>87 dBA</td>
<td>5 ft</td>
</tr>
<tr>
<td></td>
<td>Shop Vac Portable Hand Vacuum</td>
<td>83 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Ingrsl Rand Pneum Right Angle Die Grinder</td>
<td>92 dBA</td>
<td>10 ft</td>
</tr>
<tr>
<td></td>
<td>Ingrsl Rand Straight Pneum Die Grinder</td>
<td>91 dBA</td>
<td>10 ft</td>
</tr>
</tbody>
</table>
### APPENDIX C
MEASURED EQUIPMENT NOISE LEVELS
(continued)

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOURCE</th>
<th>READING</th>
<th>HAZARD RADIUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bldg 234,</td>
<td>Dewalt DC925 Cordless Hand Drill</td>
<td>88 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td>Rooms 101 D-H</td>
<td>Bosch Bull Dog Hammer Drill</td>
<td>97 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Cordless Circular Saw</td>
<td>97 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Cordless Jig Saw</td>
<td>99 dBA</td>
<td>20 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt DC970 Cordless Hand Drill</td>
<td>86 dBA</td>
<td>4 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Cordless Impact Driver</td>
<td>88 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Makita Corded Hand Disc Grinder</td>
<td>107 dBA</td>
<td>&gt;50 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Cordless Reciprocating Saw</td>
<td>98 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Corded Hand Belt Sander</td>
<td>89 dBA</td>
<td>8 ft</td>
</tr>
<tr>
<td></td>
<td>Craftsman Corded Hand Drill</td>
<td>95 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>Skil Corded Hand Drill</td>
<td>94 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Corded Hand Router</td>
<td>94 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>Wilton bench combination sanding unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1-inch vertical belt sander</td>
<td>86 dBA</td>
<td>2 ft</td>
</tr>
<tr>
<td></td>
<td>-vertical disc sander</td>
<td>97 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Haas VF6 Machinery Center</td>
<td>77 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Haas TL-3 CNC Milling Machine</td>
<td>75 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Milwaukee Corded Rotary Hammer</td>
<td>99 dBA</td>
<td>20 ft</td>
</tr>
<tr>
<td></td>
<td>Mastercraft Wet-Dry Vacuum</td>
<td>88 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Haas TM-3P Machinery Center</td>
<td>76 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Dynabrade Pneumatic Dynafile</td>
<td>90 dBA</td>
<td>12 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Corded Swivel Head Shear</td>
<td>93 dBA</td>
<td>15 ft</td>
</tr>
<tr>
<td></td>
<td>Dewalt Corded Palm Sander</td>
<td>89 dBA</td>
<td>6 ft</td>
</tr>
<tr>
<td></td>
<td>Makita Corded Hand Angle Grinder</td>
<td>93 dBA</td>
<td>10 ft</td>
</tr>
<tr>
<td>Bldg 234,</td>
<td>Baldor Cutoff Saw</td>
<td>101 dBA</td>
<td>ER</td>
</tr>
<tr>
<td>Room 101C</td>
<td>Blue Airlux Fume Eliminator Machine</td>
<td>77 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Yellow Shop Wet/Dry Shop Vac</td>
<td>88 dBA</td>
<td>3 ft</td>
</tr>
<tr>
<td></td>
<td>Red Airlux Fume Eliminator Machine</td>
<td>81 dBA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Clark Dual Pedestal Grinding Wheels</td>
<td>87 dBA</td>
<td>5 ft</td>
</tr>
<tr>
<td></td>
<td>Sioux Pneumatic Needle Scaler</td>
<td>112 dBA</td>
<td>ER</td>
</tr>
</tbody>
</table>

ER = entire room
# INDUSTRIAL HYGIENE NOISE SURVEY FORM

**Date:** 11 July 2016  **IH UIC:** 39162  **Activity:** Naval Postgraduate School  **UIC:** 62271  
**Shop Location:** Bldg 234, Room 100, Machine Shop  **Dept:** MAE Department Machinist/Model Maker

Area Posted: [ ] No  Hearing Protection In Use: [X] Single Hearing Protection-Ear Muffs

## Sound Level Meter Results

<table>
<thead>
<tr>
<th>Item #</th>
<th>Source Description</th>
<th>Machine#/SN#</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Makita Corded 4 Inch Model GA4030 Angle Grinder</td>
<td>S/N: 1036355</td>
</tr>
</tbody>
</table>

- **Noise Pattern:**
  - C = Continuous
  - IN = Intermittent
  - IM = Impulse/Impact
  - XC
  - IN
  - IM

- **Noise Source Labeled?**
  - [X] Yes
  - No

- **Noise Hazard Radius (ft)**
  - 10

- **Meter Response**
  - F = Fast
  - S = Slow
  - I = Impulse/Impact
  - F
  - XS
  - I

- **Results**
  - 93.0 dBA

**Comments:** The noise level of the grinder exceeds the Navy single hearing protection criterion level of 85 dBA and requires the wearing of either ear plugs or muffs during its operation.

## SOUND LEVEL METER

<table>
<thead>
<tr>
<th>Mfr: SKC</th>
<th>CALIBRATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model: 2400</td>
<td>Model: QC-10</td>
</tr>
<tr>
<td>Serial #: JN4040124</td>
<td>Serial #: QE6080140</td>
</tr>
</tbody>
</table>

- **Last Electroacoustic Cal Date:** 14 Jan 16  **Next Electroacoustic Cal Date:** 14 Jan 17
- **Field Calibration:** Pre-CAL Date: 11 July 2016  **Post-CAL Date:** 11 July 2016
- **Field Calibration OK:** [X] Yes  [ ] No  **Field Calibrated By:** Eric Thurston
- **Measurements Obtained:** [X] Indoors  [ ] Outdoors
- **Wind Screen:** [ ] Used  [X] Not Used

**Sampler:** Eric Thurston  **Date Completed:** 11 July 2016

**Reviewing IH:** John Salzer  **Date Reviewed:**

**Data Entered By:** Eric Thurston  **Date Entered:** 11 July 2016
**INDUSTRIAL HYGIENE NOISE SURVEY FORM**

**Date:** 8 August 2017  **IH UIC:** _39162_  **Activity:** Naval Postgraduate School  **UIC:** _62271_

**Shop Location:** Bldg 234, Room 100, Machine Shop  **Dept:** SP Department Machinist/Model Maker

**Area Posted:** [X] No  **Hearing Protection In Use:** [X] None

### Sound Level Meter Results

<table>
<thead>
<tr>
<th>Item #</th>
<th>#1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Description</td>
<td>Haas TM-3P Toolroom Milling Machine</td>
</tr>
<tr>
<td>Machine#/SN#</td>
<td>None</td>
</tr>
<tr>
<td>Noise Pattern:</td>
<td>XC</td>
</tr>
<tr>
<td>C = Continuous</td>
<td>IN</td>
</tr>
<tr>
<td>IN = Intermittent</td>
<td>IM</td>
</tr>
<tr>
<td>IM = Impulse/Impact</td>
<td></td>
</tr>
<tr>
<td>Noise Source Labeled?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>XNo</td>
</tr>
<tr>
<td>Noise Hazard Radius (ft)</td>
<td>N/A</td>
</tr>
<tr>
<td>Meter Response</td>
<td>F</td>
</tr>
<tr>
<td>F = Fast</td>
<td>XS</td>
</tr>
<tr>
<td>S = Slow</td>
<td>I</td>
</tr>
<tr>
<td>I = Impulse/Impact</td>
<td></td>
</tr>
</tbody>
</table>

**Results:** 79.3 dBA ( @ 6,000 rpm)

**Comments:** The noise level of the milling machine is below the Navy criterion level of 85 dBA and corrective action, including use of hearing protection, is unneded during its operation.

### SOUND LEVEL METER

- **Mfr:** SKC
- **Model:** 2400
- **Serial #:** JN4040124
- **Last Electroacoustic Cal Date:** 14 Jan 16
- **Field Calibration:** Pre-Cal Date: 8 August 2017  **Post-Cal Date:** 8 August 2017
- **Field Calibration OK:** [X] Yes  **No**
- **Measurement Obtained:** [X] Indoors  **No** Outdoors
- **Wind Screen:** [X] Used  **Not Used**

### CALIBRATOR

- **Mfr:** SKC
- **Model:** QC-10
- **Serial #:** QE6080140
- **Last Electroacoustic Cal Date:** 14 Jan 16

**Date Completed:** 8 August 2017

**Sample:** _Eric Thurston_  **Date Reviewed:** ________

**Data Entered By:** _Eric Thurston_  **Date Entered:** 8 August 2017
### INDUSTRIAL HYGIENE NOISE SURVEY FORM

**Date:** 9 August 2017  
**IH UIC:** 39162  
**Activity:** Naval Postgraduate School UIC: 62271  
**Shop Location:** Bldg 234, Room 100, Machine Shop  
**Dept:** MAE Department Machinist/Model Maker  
**Area Posted:** X  
**Hearing Protection In Use:** X  

#### Sound Level Meter Results

<table>
<thead>
<tr>
<th>Item #</th>
<th>Source Description</th>
<th>#1</th>
<th>Machine#/SN#</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Haas TL-3 CNC Milling Machine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise Pattern:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C = Continuous</td>
<td>XC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN = Intermittent</td>
<td>IN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM = Impulse/Impact</td>
<td>IM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Source Labeled?</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XNo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Hazard Radius (ft)</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meter Response</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S = Slow</td>
<td>XS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I = Impulse/Impact</td>
<td>I</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Results

75.0 dBA ( @ 6,000 rpm)

**Comments:** The noise level of the milling machine is below the Navy criterion level of 85 dBA and corrective action, including use of hearing protection, is unneded during its operation.

### SOUND LEVEL METER

<table>
<thead>
<tr>
<th>Mfr: SKC</th>
<th>Model: 2400</th>
<th>Serial #: JN4040124</th>
</tr>
</thead>
</table>

### CALIBRATOR

<table>
<thead>
<tr>
<th>Mfr: SKC</th>
<th>Model: QC-10</th>
<th>Serial #: QE6080140</th>
</tr>
</thead>
</table>

**Last Electroacoustic Cal Date:** 14 Jan 16  
**Next Electroacoustic Cal Date:** 14 Jan 17  
**Field Calibration:** Pre-Cal Date: 9 August 2017  
**Post-Cal Date:** 9 August 2017  
**Field Calibration OK:** X  
**Field Calibrated By:** Eric Thurston  
**Measurements Obtained:** X Indoors  
**Wind Screen:** X Not Used  
**Sampler:** Eric Thurston  
**Date Completed:** 9 August 2017  
**Reviewing IH:** John Salzer  
**Date Reviewed:**  
**Data Entered By:** Eric Thurston  
**Date Entered:** 9 August 2017
APPENDIX E
RESPIRATORY PROTECTION PROGRAM MATRIX

Respirators are not required during performance of departmental operations.

The MAE Department Machinist/Model Maker voluntarily wears 3M Model 8210 disposable respirators to minimize inhalation of mist created during use of minimally toxic Simple Green Cleaning Solution, and minimal airborne wood dust and manmade vitreous fibers (MMVF) generated during work with wood, and with fiberglass materials or carbon fiber cloth during composites fabrication. The Space Systems Academic Group Machinist/Model Maker rarely wears the same respirator during such jobs as manual removal of rust from steel stock that causes slight levels of airborne iron oxide dust.
APPENDIX F
EXPOSURE-BASED
MEDICAL SURVEILLANCE MATRIX

COMMAND: Naval Postgraduate School
DATE: August 2017
DEPARTMENT: Combined Machine Shop, MAE Dept/SP Academic Group

<table>
<thead>
<tr>
<th>JOB/PROCESS</th>
<th>MEDICAL SURVEILLANCE PROGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Machinist/Model Makers</td>
<td>Noise (503), Metal Working Fluids (162)</td>
</tr>
<tr>
<td>SP Machinist/Model Maker, welding</td>
<td>Welders/Brazers (708)</td>
</tr>
</tbody>
</table>

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; instructions for accessing the manual online can be found at www.nmcphe.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 Presidio of Monterey’s Occupational Health Department’s policy is for the supervisor(s) to contact them for scheduling exams instead of individual workers scheduling themselves.

All exams are required yearly.

Recommendations for enrollment in the Metal Working Fluids program is not based on inhalation of fluid mists, but on the potential for significant skin irritation/disease from skin contact. The Welder/Brazer program focuses on potential ultraviolet (UV) radiation effects on the worker’s eyes.

Termination Noise exams are also required, which are necessary as soon as practical after the worker’s performance of the job process involving significant exposure to hazardous noise ends, resulting from the process no longer being performed, worker reassignment, or termination of employment.
## APPENDIX G
### EXPOSURE-BASED TRAINING MATRIX

**COMMAND:** Naval Postgraduate School, Monterey  
**DATE:** August 2017  
**DEPARTMENT:** Combined Halligan Hall Machine Shop, MAE Dept/SP Academic Group

<table>
<thead>
<tr>
<th>PROCESS/PRODUCT</th>
<th>ESAMS TRAINING MODULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Machinists</td>
<td>Basic HAZCOM Training (1169), HAZCOM Job/Chemical Specific (OJT-100)*, PPE-Initial (1398), PPE-Job Specific (239), Hearing Conservation (110)</td>
</tr>
<tr>
<td>MAE Machinist use of Crafticks Plastick Acrylic Liquid Solvent or acrylic cement</td>
<td>Methylene Chloride Awareness OJT (399)</td>
</tr>
<tr>
<td>SP Machinist use of Anti-Spatter MIG welding chemical products</td>
<td>Methylene Chloride Awareness OJT (399)</td>
</tr>
<tr>
<td>La-Co markers, aerosol paint or primer cans, or alcohols</td>
<td>Occupational Reproductive Hazard Awareness (1242), Reproductive Hazard Job Specific (197)</td>
</tr>
<tr>
<td>Supervisors of Machinists/Model Makers</td>
<td>HAZCOM Training For Supervisors (1058)</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>TERM</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Action Level - Normally half of PEL. Exposure level at which air sampling, employee training, and medical surveillance are required.</td>
</tr>
<tr>
<td>ACGIH</td>
<td>American Conference of Government Industrial Hygienist</td>
</tr>
<tr>
<td>AC/HR</td>
<td>Air Changes per Hour</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AQS</td>
<td>Air Quality Standard</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>American Society of Heating, Refrigeration, and Air Conditioning Engineers</td>
</tr>
<tr>
<td>C</td>
<td>Ceiling - Toxic material exposure level which cannot be exceeded for any length of time.</td>
</tr>
<tr>
<td>cfm</td>
<td>Cubic feet per minute</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulation</td>
</tr>
<tr>
<td>EL</td>
<td>Excursion Limit - Concentration limit which cannot be exceeded at any time.</td>
</tr>
<tr>
<td>EAMP</td>
<td>Exposure Assessment/Monitoring Program. A program to evaluate workplace health hazards through surveys and exposure measurement.</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>FC</td>
<td>Footcandles</td>
</tr>
<tr>
<td>f/cc</td>
<td>Fibers Per Cubic Centimeter. A means for expressing airborne fiber concentrations.</td>
</tr>
<tr>
<td>fpm</td>
<td>Feet per minute</td>
</tr>
<tr>
<td>ft³</td>
<td>Cubic feet</td>
</tr>
<tr>
<td>HDI</td>
<td>Hexamethylene Diisocyanate</td>
</tr>
<tr>
<td>HEPA</td>
<td>High Efficiency Particulate Air</td>
</tr>
<tr>
<td>HM</td>
<td>Hazardous Material</td>
</tr>
<tr>
<td>HMC&amp;M</td>
<td>Hazardous Material Control and Management</td>
</tr>
<tr>
<td>HW</td>
<td>Hazardous Waste</td>
</tr>
<tr>
<td>IES</td>
<td>Illumination Engineering Society</td>
</tr>
<tr>
<td>IH</td>
<td>Industrial Hygiene</td>
</tr>
<tr>
<td>L</td>
<td>Liter</td>
</tr>
<tr>
<td>Lpm</td>
<td>Liters per minute</td>
</tr>
<tr>
<td>LOD</td>
<td>Limit of Detection</td>
</tr>
<tr>
<td>LOQ</td>
<td>Limit of Quantitation</td>
</tr>
<tr>
<td>mg/m³</td>
<td>Milligrams per cubic meter of air. A means of expressing concentrations of dust and metal fumes in the air.</td>
</tr>
<tr>
<td>MSAL</td>
<td>Medical Surveillance Action Level. Concentration of air contaminant at which medical surveillance examinations must be provided to exposed personnel.</td>
</tr>
<tr>
<td>NAVOSH</td>
<td>Navy Occupational Safety and Health</td>
</tr>
<tr>
<td>NEHC</td>
<td>Navy Environmental Health Center</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute of Occupational Safety and Health</td>
</tr>
<tr>
<td>OEL</td>
<td>Occupational Exposure Limit</td>
</tr>
<tr>
<td>TERM</td>
<td>MEANING</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>OH/PM</td>
<td>Occupational Health/Preventive Medicine</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
</tr>
<tr>
<td>OV</td>
<td>Organic Vapor</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>ppm</td>
<td>Parts per million. A means of expressing the concentration of gases and vapors in the air.</td>
</tr>
<tr>
<td>psi</td>
<td>Pounds per square inch</td>
</tr>
<tr>
<td>RFR</td>
<td>Radio Frequency Radiation</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
</tr>
<tr>
<td>SqFt</td>
<td>Square Feet</td>
</tr>
<tr>
<td>SDS</td>
<td>Safety Data Sheet. Formerly termed Material Safety Data Sheet. A form used by manufacturers to communicate to users the chemical and physical properties of their products.</td>
</tr>
<tr>
<td>STEL</td>
<td>Short Term Exposure Limit. A 15-minute time weighted average exposure which should not be exceeded at anytime during a workday.</td>
</tr>
<tr>
<td>Stressor</td>
<td>Potential hazard (e.g. noise, chemicals, dusts, etc.)</td>
</tr>
<tr>
<td>TLV</td>
<td>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.</td>
</tr>
<tr>
<td>TWA</td>
<td>Time Weighted Average. A method of averaging varying concentrations over a specified period of time, usually 8 hours.</td>
</tr>
<tr>
<td>ug</td>
<td>Microgram</td>
</tr>
<tr>
<td>Vol</td>
<td>Volume</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
</tbody>
</table>