June 2020

PERSONNEL COMPETENCY STANDARD

Industrial Hygiene Department Personnel Competency Standard for developmental military and civilian industrial hygienists and technicians

Name:_____

NAVY AND MARINE CORPS PUBLIC HEALTH CENTER
INDUSTRIAL HYGIENE START HERE

June 20, 2020

Acknowledgements

The NMCPHC would like to extend a special thanks to the Navy Medicine Readiness Training Command Bremerton Industrial Hygiene office for providing their Personnel Competency Standard document as a template. It is evident that much time and effort was put into their document and the NMCPHC is extremely grateful for their contribution.

June 20, 2020

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INTRODUCTION

PERSONNEL COMPETENCY STANDARD

The Industrial Hygiene Department Personnel Competency Standard (PCS) is a suggested competency system of basic industrial hygiene techniques and knowledge designed to establish the minimum level of competency required for developmental military and civilian industrial hygienists and technicians to successfully perform in their positions. The PCS is a compilation of the minimum knowledge and skills that personnel must demonstrate in order to accomplish industrial hygiene primary functions. The objective is to standardize the training of personnel new to the practice of industrial hygiene.

CONTENTS

Each subject of the PCS is divided into three sections. Fundamentals sections contain written resources (i.e., technical manuals and major references) that provide an overview of the general principles and information required to understand and satisfactorily perform basic industrial hygiene duties and responsibilities. Practicals sections provide practical demonstrations of field operations and techniques to put the knowledge gained from the fundamental sections to use. The certifier for a practicals section should ensure that the fundamental topics of the section are covered. The practicals section is designed to acquaint personnel with monitoring equipment, requirements, and best practices. Problem solving sections contain common industrial hygiene calculations to solve.

REFERENCES

The references used during the writing of this standard were the latest available to the Industrial Hygiene Department; however, the most current references available should be used when completing the industrial hygiene subjects.

CERTIFIERS

The certifiers are supervisors, industrial hygienists and technicians who are experienced in the industrial hygiene subjects. They certify that a Practical item has been completed. Only a Supervisor can signify the completion of subjects either by written or oral examination, or by observation of performance of competencies found in the standard.

DEVELOPMENTAL PROFESSIONALS

The supervisors will tell developmental industrial hygienists and technicians which industrial hygiene subjects to complete and in what order. If a person is unable to physically demonstrate a subject performance factor in the practicals section, he/she will need to demonstrate a basic understanding of the performance factor in the opinion of the certifier.

FINAL COMPETENCY

Satisfactory completion of the PCS is required prior to achieving final competency.

June 20, 2020

FINAL COMPETENCY

Fundamentals | Practicals | Problem Solving

Industrial Hygiene Department

NAME: _____

POSITION: Industrial Hygienist | Industrial Hygiene Technician

This page is to be kept in the individual's training file as a record of satisfactory completion of the Personnel Competency Standard for basic industrial hygiene.

RECOMMENDED: _____ DATE: _____
Supervisor

RECOMMENDED: _____ DATE: _____
Assistant Department Head

CERTIFIED: _____ DATE: _____
Department Head

June 20, 2020

LIST OF CERTIFIERS

The certifiers provide training in the knowledge and skills required to build and maintain competency and proficiency in the practice of industrial hygiene. The table below lists the certifiers assigned to the industrial hygiene subjects to include fundamentals, practicals, and problem solving sections. The Supervisor lists the staff members that may certify items in each section when the PCS is begun.

Industrial Hygiene Subject	Certifier
101 Department Orientation	
102 General Principles of Industrial Hygiene	
103 Industrial Toxicology	
104 Exposure Assessment Strategies	
105 Air Sampling	
106 Bulk and Surface Wipe Sampling	
107 Industrial Noise	
108 Non-ionizing Radiation	
109 Ergonomics	
110 Heat Stress	
111 Bloodborne Pathogens	
112 Indoor Environmental Quality	
113 Industrial Ventilation	
114 Personal Protective Equipment	
115 Equipment Maintenance and Calibration	
116 OSHA Expanded Standards	
117 Navy SOH Programs	
118 Industrial Process Assessments	
119 Industrial Hygiene Surveys and Reports	
120 DOEHRS-IH Application	

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LIST OF INDUSTRIAL HYGIENE SUBJECTS

The industrial hygienist and industrial hygiene technician are expected to complete the industrial hygiene subjects in the table below. Each subject contains line items that need to be completed by both the industrial hygienist and industrial hygiene technician.

Industrial Hygiene Subject
101 Department Orientation
102 General Principles of Industrial Hygiene
103 Industrial Toxicology
104 Exposure Assessment Strategies
105 Air Sampling
106 Bulk and Surface Wipe Sampling
107 Industrial Noise
108 Non-ionizing Radiation
109 Ergonomics
110 Heat Stress
111 Bloodborne Pathogens
112 Indoor Environmental Quality
113 Industrial Ventilation
114 Personal Protective Equipment
115 Equipment Maintenance and Calibration
116 OSHA Expanded Standards
117 Navy SOH Programs
118 Industrial Process Assessments
119 Industrial Hygiene Surveys and Reports
120 DOEHRS-IH Application

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101 DEPARTMENT ORIENTATION

Completed: _____ _____
Supervisor Date

References:

A. Department Head, Assistant Department Head, and Supervisors. Industrial Hygiene Department.

Section I: Fundamentals

101.01 Discuss the Industrial Hygiene Department's mission and area of responsibility (AOR)

.02 Discuss the organizational structure of the command / medical treatment facility and Industrial Hygiene Department, as well as any supported organizations.

.03 Discuss the general roles and responsibilities of an industrial hygienist and industrial hygiene technician.

.04 Discuss the working relationship between industrial hygiene and safety, audiology, preventive medicine, and occupational health.

.05 Identify the Navy ships and submarines homeported in the Industrial Hygiene Department's AOR.

.06 Identify the Navy military ranks, including officers and enlisted.

.07 Discuss the proper customs and courtesies rendered towards customers, co-workers, supervisors, and military leadership.

Section II: Practicals

101.08 If applicable: Take a familiarization tour aboard a ship or submarine.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

- END OF 101 -

102 GENERAL PRINCIPLES OF INDUSTRIAL HYGIENE

Completed: _____ _____
Supervisor Date

References:

A. The Occupational Environment: Its Evaluation, Control, and Management. In S. R. DiNardi (2nd Edition). American Industrial Hygiene Association, 2003.
B. The Occupational Environment: Its Evaluation, Control, and Management. In Daniel H. Anna (3rd Edition). American Industrial Hygiene Association, 2011.
C. Fundamentals of Industrial Hygiene. In B. A. Plog (6th Edition). National Safety Council, 2012.
D. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Industrial Hygiene Surveys and Survey Reports, Chapter 2. Navy and Marine Corps Public Health Center.
E. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Exposure Assessment Strategies, Chapter 4. Navy and Marine Corps Public Health Center.
F. Medical Surveillance Procedures Manual and Medical Matrix (12th Edition), NMCPHC-TM OM 6260. Navy and Marine Corps Public Health Center, August 2015.
G. OPNAVINST 5100.23 series.
H. OPNAVINST 5100.19 series.
I. BUMEDINST 5100.13 series.

Section I: Fundamentals

102.01 Attend the Navy and Marine Corps Public Health Center (NMCPHC) "Introduction to Industrial Hygiene for Exposure Monitors and Industrial Hygiene Technician / Industrial Hygiene Techniques and Exposure Monitoring" course (or equivalent)

.02 Define industrial hygiene.

.03 Discuss the six canons of the joint "Code of Ethics for the Professional Practice of Industrial Hygiene" endorsed by the American Academy of Industrial Hygiene (AAIH), American Board of Industrial Hygiene (ABIH), American Conference of Governmental Industrial Hygienists (ACGIH), and American Industrial Hygiene Association (AIHA).

.04 State the four classifications of stressors that can exist in the workplace.

.06 Discuss how to perform qualitative exposure assessments for potential health hazards from workplace stressors.

.07 Identify the different types of quantitative sampling methods (compliance and screening) used to evaluate worker exposures from workplace stressors.

.08 Discuss how to interpret and report exposure monitoring results.

.09 Describe the hierarchy of controls, including the ALARA concept, to minimize or eliminate exposures to workplace stressors.

.10 Discuss the general exposure criteria to workplace stressors for the inclusion of workers in the Navy's medical surveillance programs.

.11 Discuss the industrial hygiene survey process to include preparation, entry/exit briefs, site visit, interviews/fact finding, observations, sampling, review of results, making conclusions and recommendations, and report writing.

.12 Identify the industrial hygiene literature commonly used to comply with the standards and guidelines established by the Navy, government, and advisory agencies.

Section II: Practicals

102.13 Accompany an experienced industrial hygienist during a baseline industrial hygiene survey (BIHS)/entry brief or periodic industrial hygiene survey (PIHS) of the three types listed.

(1) Priority 1 _____
Date completed

(2) Priority 2 _____
Date completed

(3) Priority 3 _____
Date completed

_____ _____
Certifier name and signature Date completed

.14 Accompany an experienced industrial hygienist during a shipboard industrial hygiene survey.

.15 Accompany an experienced industrial hygienist during a special industrial hygiene survey.

_____ _____
Certifier name and signature Date completed

.16 During an industrial hygiene survey, work with an experienced industrial hygienist to evaluate the following stressors/routes of entry and decide if qualitative or quantitative exposure assessment is appropriate (at least five listed, as applicable):

(1) Chemical inhalation
_____
Date completed

(2) Chemical contact
_____
Date completed

(3) Chemical ingestion
_____
Date completed

(4) Noise
_____
Date completed

(5) Hand-arm and whole body vibration
_____
Date completed

(6) Heat stress and thermal contact
_____
Date completed

(7) Ultraviolet and infrared radiation
_____
Date completed

(8) Ergonomic (e.g., heavy lifting, repetition, and awkward posture)
_____
Date completed

_____ _____
Certifier name and signature Date completed

.17 During an industrial hygiene survey, work with an experienced industrial hygienist to evaluate the following engineering controls (as many controls listed, as possible):

(1) Substitution _____
Date completed

(2) Isolation _____
Date completed

(3) Ventilation _____
Date completed

_____ _____
Certifier name and signature Date completed

.18 During an industrial hygiene survey, work with an experienced industrial hygienist to evaluate the following administrative and work practice controls (as many controls listed, as possible):

(1) Supervision _____
Date completed

(2) Job rotation _____
Date completed

(3) Work/Rest cycle _____
Date completed

(4) Hazardous material storage and labels _____
Date completed

(5) Warning/Caution signs _____
Date completed

(6) Training _____
Date completed

(7) Standard operating procedure (SOP) _____
Date completed

(8) Housekeeping and personal hygiene _____
Date completed

_____ _____
Certifier name and signature Date completed

.19 During an industrial hygiene survey, work with an experienced industrial hygienist to evaluate the following personal protective equipment (PPE) (all PPE listed, if possible):

(1) Chemical goggles _____ Date completed

(2) Safety glasses _____ Date completed

(3) Face shield _____ Date completed

(4) Welding helmet and goggles _____ Date completed

(5) Leather jacket, apron, and gloves _____ Date completed

(6) Rubber apron _____ Date completed

(7) Chemical gloves _____ Date completed

(8) Cotton or chemical-resistant coveralls _____ Date completed

(9) Ear plugs and circumaural muffs _____ Date completed

(10) Air-purify respirator (filtering facepiece, chemical cartridge) _____ Date completed

(11) Supplied-air respirator _____ Date completed

_____ _____
Certifier name and signature Date completed

.20 Conduct a command or shop entry and/or out-brief of an industrial hygiene survey under the supervision of an experienced industrial hygienist.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

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June 20, 2020

103 INDUSTRIAL TOXICOLOGY

Completed: _____ _____
Supervisor Date

References:

A. Casarett and Doull's Toxicology: The Basic Science of Poisons. In C. D. Klaassen (9th Edition). The McGraw-Hill Companies, 2019.
B. NIOSH Pocket Guide to Chemical Hazards. National Institute for Occupational Safety and Health, 2007.
C. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.
D. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Agents Classified by the IARC Monographs, Volumes 1-116. International Agency for Research on Cancer, 2016.
E. National Toxicology Program. Report on Carcinogens (14th Edition). U.S. Department of Health and Human Services, 2016.
F. Medical Surveillance Procedures Manual and Medical Matrix (12th Edition), Technical Manual NMCPHC-TM OM 6260. Navy and Marine Corps Public Health Center, August 2015.
G. Reproductive and Developmental Hazards: A Guide for Occupational Health Professionals, Technical Manual NMCPHC-TM-OEM 6260.01C. Navy and Marine Corps Public Health Center, May 2019

Section I: Fundamentals

103.01 Define toxicity, hazard, carcinogen, mutagen, teratogen, and sensitizer.

.02 Identify the different physical forms in which chemicals can exist.

.03 State the routes of entry in which a chemical can enter the body.

.04 Identify the different sizes of inhalable, thoracic, and respirable particulate matter and explain their deposition in the respiratory tract (nasal passages, conducting airways, and gas exchange region).

.05 Explain the difference between the following health effects: (1) systemic versus localized, (2) acute versus chronic, (3) reversible versus irreversible, and (4) allergic versus sensitization.

.06 Define hepatotoxic, nephrotoxic, and neurotoxic agents.

.07 Explain the difference between chemical and simple asphyxiants.

.08 Discuss the criteria for a chemical being placed on a list of carcinogens and identify the classification systems used by Occupational Safety and health Administration (OSHA), International Agency for Research on Cancer (IARC), National Toxicology Program (NTP), and ACGIH.

.09 Discuss the dose-response relationship to include curves, threshold, lethal dose, concentration dose, no observable adverse effect level (NOAEL), and lowest observable adverse effect level (LOAEL).

.10 Explain the difference between threshold and linear non-threshold models.

.11 Discuss how to select a NOAEL and LOAEL.

.12 Discuss the four phases (absorption, distribution, metabolism, and excretion) to the disposition of chemicals in the body, also known as toxicokinetics.

.13 Define additive, synergistic, potentiation, and antagonistic health effects from chemical reactions.

.14 Explain the difference between primary and secondary irritants.

.15 Identify the different types of biological monitoring to measure chemicals or chemical metabolites (biomarkers) in biological samples of the human body.

.16 Discuss the limitations and strengths of using animal data to assess reproductive and developmental hazards to humans.

Section II: Practicals

None

Section III: Problem Solving

None

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104 EXPOSURE ASSESSMENT STRATEGIES

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Industrial Hygiene Surveys and Survey Reports, Chapter 2. Navy and Marine Corps Public Health Center.
B. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Exposure Assessment Strategies, Chapter 4. Navy and Marine Corps Public Health Center.
C. A Strategy for Assessing and Managing Occupational Exposures. (4th Edition). American Industrial Hygiene Association, 2015.
D. Tools for the practicing Industrial hygienist. Exposure Assessment Strategies Committee. American Industrial Hygiene Association. https://aiha.org/public-resources/consumer-resources/topics-of-interest/ih-apps-tools
E. Applied Statistics in Occupational Safety and Health. In C. A. Janicak (3rd Edition). Government Institutes, 2016.
F. Defense Occupational Environmental Health Readiness System-Industrial Hygiene (DOEHRS-IH)
G. OPNAVINST 5100.23 series.
H. Code of Federal Regulations, Title 29, Part 1910.1000. Air Contaminants. and other substance specific sections. Occupational Safety and Health Administration.
I. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.

Section I: Fundamentals

104.01 Describe the DoD exposure assessment model.

.02 Describe the five major steps of the Navy's industrial hygiene exposure assessment process.

.03 State the eight common bases for defining similar exposure groups (SEGs) through observation.

.04 Explain the difference between qualitative and quantitative exposure assessments.

.05 Define action level (AL) and the following occupational exposure limits (OELs): (1) 8-hour time weighted average (TWA), (2) short-term exposure limit (STEL), (3) ceiling (C), and (4) excursion limit (EL).

.06 Explain how to choose appropriate OELs based on the Navy hierarchy.

.07 Explain how to convert between different OEL units.

.08 Identify the type of statistical test used to determine if exposure monitoring data is lognormally distributed and state the statistics typically used to estimate exposures in the upper tail of the SEG exposure profile distribution.

.09 Define an exposure profile of a SEG as acceptable, uncertain, and unacceptable, considering the uncertainty around the OEL and around the exposure estimate.

.10 Discuss the levels of confidence in hazard/exposure characterization and existing controls.

.11 Explain how to assign a health risk rating (HRR) to a SEG using exposure and health effect ratings.

.12 Describe the process of entering, updating, and tracking exposure monitoring data in the Industrial Hygiene Department's exposure monitoring plan (EMP).

Section II: Practicals

104.13 Enter EMP events from a PIHS report into the Industrial Hygiene Department's EMP under the supervision of an experienced industrial hygienist.

_____ _____
Certifier name and signature Date completed

.14 During an industrial hygiene survey, work with an experienced industrial hygienist to perform the two types of exposure assessments listed.

(1) Quantitative

_____
Date completed

(2) Qualitative

_____
Date completed

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

Refer to Chapters 2 and 4 of the NMCPHC Industrial Hygiene Field Operations Manual to solve problems 104.15 through 104.18.

104.15 Calculate the HRR for instructors at a weapons firing range who are expected to be routinely overexposed to noise.

.16 Calculate the HRR for workers repairing aircraft composite structures who are expected to be infrequently exposed to fibrous glass (nuisance dust) at less than 10 percent of the OEL.

.17 Calculate the HRR for painters applying primer to ground support equipment who are expected to be routinely exposed to hexavalent chromium (human carcinogen) at less than 50 percent of the OEL.

.18 Demonstrate the calculation and use of quantitative exposure assessment statistics using DOEHRS-IH or other tools under the supervision of an experienced industrial hygienist

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105 AIR SAMPLING

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Sampling Procedures, Chapter 3. Navy and Marine Corps Public Health Center.
B. OSHA Technical Manual. Personal Sampling for Air Contaminants, Section II, Chapter 1. Occupational Safety and Health Administration.
C. Industrial Hygiene Sampling Guide for Navy Comprehensive Industrial Hygiene Laboratories (CIHLs). Navy and Marine Corps Public Health Center. 2018.
D. Exposure Monitoring and industrial Hygiene Techniques Course. NMCPHC.
E. Index of OSHA Sampling and Analytical Methods. Occupational Safety and Health Administration.
F. NIOSH Manual of Analytical Methods. National Institute for Occupational Safety and Health.
G. Bisesi and Kohn's Industrial Hygiene Evaluation Methods. In M. S. Bisesi (2nd Edition). Lewis Publishers, 2004.
H. Code of Federal Regulations, Title 29, Part 1910.1000. Air Contaminants. and other substance specific sections. Occupational Safety and Health Administration.
I. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.

Section I: Fundamentals

105.01 Discuss the reasons for air sampling and when to sample.

.02 Discuss determining representative sampling and SEGs.

.03 Discuss and identify how many samples should be taken when conducting air sampling of a work population and what individuals to select for monitoring.

.04 Discuss the various variability parameters and other factors that affect sampling.

.05 Explain the difference between the following types of air sampling methods: (1) compliance versus screening, (2) personal versus general area, (3) active versus passive, and (4) direct versus indirect.

.06 Explain the difference between the following types of air sampling duration types: (1) Full shift (continuous, integrated, TWA), short term (STEL, ceiling), instantaneous (direct reading, grab)

.07 Define and describe the advantages and disadvantages of the following air sampling duration strategies: (1) full period single sample, (2) full period consecutive samples, (3) partial period single sample, (4) partial period consecutive samples, and (5) instantaneous samples.

.08 Explain where to find the standard procedures to determine the sampling criteria (e.g., flow rate, sample volume, and collection media).

.09 Discuss the use and limitations of detector tubes.

.10 Discuss the use of passive air sampling monitors.

.11 Identify the main components of a calibration train and air sampling train.

.12 Discuss the selection and use of air sampling pumps, collection media, and calibrators to monitor for the following: (1) organic vapors, (2) metal fumes, (3) total and respirable dust, (4) asbestos fibers, and (5) isocyanates.

.13 Discuss where to position the sample and pump when conducting personal and general area air sampling

.14 Explain the difference between an open and closed face cassette.

.15 Identify the different types of cyclones used to capture respirable particulate matter.

.16 Discuss the use of an IOM sampler and the particulate mass fraction collected.

.17 Define “breakthrough” as it pertains to sorbent tubes.

.18 Discuss how long a sample must be taken to meet the minimum air volume standard criteria (e.g., ceiling, STEL, and 8-hour).

.19 Discuss what information should be included in the sampling field notes.

.20 Explain the difference between field and media blanks and state the number of blanks collected for each batch of samples in accordance with CIHL policy.

.21 Discuss how to correctly fill out the NMCPHC/local air sample survey forms and logs, assign sample numbers, and properly pack and ship samples to the Navy’s CIHL.

.22 Explain the air sampling equations found in Attachment (A) of this standard.

.23 Define the analytical limit of quantification (LOQ) and explain when to censor sample results.

.24 Explain when sampling data is invalid due to sampling and analytical errors (SAEs) and/or random errors.

.25 Explain what you should do in the case of any less than LOQ results from a metal scan to determine if that metal was truly present and less than the LOQ, as opposed to just not being present at all. Explain how erroneously including less than LOQ metal scan results where the metal was just not present at all can skew statistical assessment of SEG exposure data.

Section II: Practicals

105.26 Conduct personal air sampling for contaminants under the supervision of an experienced industrial hygienist or industrial hygiene technician. This is to include:

(1) Selecting sampling method. _____
Date completed

(2) Selecting air sampling pump and calibrator. _____
Date completed

(3) Selecting sampling media. _____
Date completed

(4) Determining the needed flow rate. _____
Date completed

(5) Determining the needed sample volume. _____
Date completed

(6) Setting up calibration and sampling trains. _____
Date completed

(7) Calibrating sampling pump. _____
Date completed

(8) Collecting field and media blanks. _____
Date completed

(9) Completing sample form/logs. _____
Date completed

(10) Assigning sample numbers. _____ Date completed

(11) Packaging and shipping samples. _____ Date completed

_____ _____
Certifier name and signature Date completed

.27 Conduct personal or general area air sampling for the following physical forms of contaminants under the supervision of an experienced industrial hygienist or industrial hygiene technician:

(1) Particulate _____ Date completed

(2) Gas or vapor _____ Date completed

_____ _____
Certifier name and signature Date completed

.28 Conduct personal or general area air sampling for the following analytes (at least three chemicals listed, as applicable) under the supervision of an experienced industrial hygienist or industrial hygiene technician:

(1) Asbestos (any form) _____ Date completed

(2) Benzene _____ Date completed

(3) Hexavalent chromium _____ Date completed

(4) Isocyanate (HDI, MDI or TDI) _____ Date completed

(5) Lead _____ Date completed

(6) Respirable silica (crystalline or cristobalite) _____ Date completed

_____ _____
Certifier name and signature Date completed

.29 Collect an organic vapor sample using a passive air monitoring badge and complete the appropriate survey form under the supervision of an experienced industrial hygienist or industrial hygiene technician:

_____ _____
Certifier name and signature Date completed

.30 Calculate the following under the supervision of an experienced industrial hygienist:

(1) Performing censoring calculations. _____
Date completed

(2) Actual TWA _____
Date completed

(3) 8-hour TWA
unsampled period = 0
unsampled period = sampled period _____
Date completed

(4) 15-minute short term exposure limit (STEL) _____
Date completed

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

Use the following benzene air sampling parameters (OSHA Method 7) from the Navy's CIHL sampling guide table to solve problems 105.31 through 105.35.

Analyte: Benzene CAS: 71-43-2 MW: 78.11 OSHA 8 hour TWA Permissible Exposure Limit (PEL) 1 ppm OSHA STEL 5 ppm		
Flow Rate (lpm)8	Volume (L)	LOQ (µg)
0.01 to 0.2	2 to 10	2

105.31 Convert the OSHA PEL of 1 ppm to mg/m^3 and the STEL of 5 ppm to mg/m^3.

.32 Calculate the minimum sample volume (L) if the airborne concentration is at the OSHA PEL-TWA.

.33 Calculate the flow rate (lpm) needed in order to collect a full 8-hour sample using one charcoal tube.

.34 Calculate the minimum sample volume (L) if the airborne concentration is at the OSHA STEL.

.35 Calculate the flow rate (lpm) in order to sample for a 15-minute STEL using one charcoal tube.

.36 Calculate the percent (%) error for the initial and final calibration flow rate differential if a sampling pump was pre-calibrated at 0.132 lpm and post-calibrated at 0.127 lpm

Scenario. A shipyard worker was sampled for exposure to benzene while performing preventive maintenance system (PMS) actions on fuel storage tanks. The PMS procedures are performed one day a week, ranging from 7 to 8 hours, during a 5-day work week. The benzene samples were partial period consecutive samples taking during a 7 hour period to identify differing exposures during that work day. One sample was an additional STEL sample taken with another sampling train during a potentially high-concentration task. The results of the samples are below. Solve problems 105.37 through 105.44.

Sample #	Duration	Concentration (ppm)
1	3 hrs	1.2
2	15 mins	5.2
3	2 hrs	0.5
4	2 hrs	0.8

.37 Calculate the actual TWA exposure in ppm.

.38 Assume the worker works an 8-hour shift and that for the unsampled period there was no exposure. Calculate the 8 hour TWA exposure in ppm.

.39 Evaluate the compliance of that 8 hour TWA exposure against the OSHA PEL-TWA, AL, STEL and ACGIH TLV-TWA and STEL

.40 Based on that one sample and 29 CFR 1910.1028, determine the monitoring frequency and if the exposure necessitates worker inclusion in the Navy's Medical Surveillance Program (Benzene 117 via Medical Matrix).

.41 Assume the worker works a 12-hour shift, and in the remaining 5 hours there was no exposure. Calculate the 12 hour TWA exposure in ppm.

.42 Calculate the adjusted PEL 12 hour TWA in ppm using the Brief and Scala model.

.43 Evaluate the compliance of that 12-hour TWA exposure against the adjusted PEL 12 hour TWA.

.44 Determine the monitoring frequency and if the exposure necessitates worker inclusion in the Navy's Medical Surveillance Program (Benzene 117 via Medical Matrix).

.45 A worker is exposed to 3.9 mg/m3 of hydrogen bromide and 2.4 mg/m3 of hydrogen chloride simultaneously. Using the ACGIH TLVs and assuming additive effects (upper respiratory tract irritants), calculate whether the exposure exceeds the TLV-C for mixtures.

.46 A “metal scan” sample was collected on a welder while performing shielded metal arc welding (stick welding). The Navy’s CIHL reported an iron (Fe_2) concentration of 2.5 mg/m3 and zinc (Zn) concentration of 1.8 mg/m3. Convert the reported concentrations to iron oxide (Fe_2O_3) and zinc oxide (ZnO) in mg/m3 since the OSHA PELs are for Fe_2O_3 and ZnO fume.

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106 BULK AND SURFACE WIPE SAMPLING

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Sampling Procedures, Chapter 3. Navy and Marine Corps Public Health Center.
B. OSHA Technical Manual. Surface Contaminants, Skin Exposure, Biological Monitoring and Other Analyses, Section II: Chapter 2. Occupational Safety and Health Administration.

Section I: Fundamentals

106.01 Explain why surface contamination in some workplaces may need to be assessed.

.02 Discuss when bulk or surface wipe sampling for contaminants is appropriate.

.03 Identify a few common non-industrial areas in a workplace that may be at risk to the spread of contaminates generated from industrial processes.

.04 Discuss various workplace controls to prevent the spread of particulates generated from industrial processes.

.05 Explain the difference between settling and direct transfer of particulate "surface loading."

.06 Describe the procedures to collect bulk and surface wipe samples and state the three types of media recommended for collecting surface samples.

.07 State the OSHA's surface loading policy for metal dusts (e.g., lead) in both industrial (regulated and non-regulated) and non-industrial workplaces.

.08 Discuss how to correctly fill out the NMCPHC bulk/wipe sample form, assign sample numbers, and properly pack and ship samples to the Navy's CIHL.

Section II: Practicals

106.09 Collect a bulk sample of a possible contaminant under the supervision of an experienced industrial hygienist or industrial hygiene technician. This is to include:

(1) Completing sample form. _____
Date completed

(2) Assigning sample numbers. _____
Date completed

(3) Packaging and shipping sample. _____
Date completed

_____ _____
Certifier name and signature Date completed

.10 Conduct wipe sampling for possible surface contamination under the supervision of an experienced industrial hygienist or technician. This is to include:

(1) Selecting sampling method. _____
Date completed

(2) Selecting sampling media. _____
Date completed

(3) Completing sample form. _____
Date completed

(4) Assigning sample numbers. _____
Date completed

(5) Packaging and shipping sample. _____
Date completed

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

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June 20, 2020

107 INDUSTRIAL NOISE

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.19 Series. Hearing Conservation, Chapter B4. Navy Safety and Occupational Health Program Manual for Forces Afloat, May 2019.
B. OPNAVINST 5100.23 Series. Hearing Conservation and Noise Abatement, Chapter 18. Navy Safety and Occupational Health Program Manual, May 2019.
C. DoD Instruction 6055.12. Hearing Conservation Program. Department of Defense, August 2019.
D. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Noise Surveys, Chapter 5. Navy and Marine Corps Public Health Center, July 2019
E. Medical Surveillance Procedures Manual and Medical Matrix (12th Edition), Technical Manual NMCPHC-TM OM 6260. Navy and Marine Corps Public Health Center, August 2015.
F. Reproductive and Developmental Hazards: A Guide for Occupational Health Professionals, Technical Manual NMCPHC-TM-6260.01D. Navy and Marine Corps Public Health Center, May 2019
G. The Noise Manual. In E. H. Berger, et al (5th Edition). American Industrial Hygiene Association, 2003

Section I: Fundamentals

107.01 Define the following basic characteristics of a sound wave: (1) frequency (f), (2) wavelength (λ), (3) amplitude, and (4) speed (c).

.02 Define the following quantities and units of sound: (1) sound power, (2) sound intensity, (3) sound pressure level, and (4) decibel.

.03 Discuss the physiology of hearing and the basic anatomy of the ear (three sections).

.04 Discuss the following types of hearing loss: (1) conductive, (2) sensorineural, and (3) central.

.05 Explain the difference between temporary threshold shift and permanent threshold shift.

.06 Identify a few non-auditory effects to noise.

.07 Define the following types of noise: (1) continuous, (2) intermittent, (3) impact, and (4) impulse.

.08 Define the following types of sound fields: (1) near field, (2) far field, (3) free field, and (4) reverberant field.

.09 Describe the operations of a sound level meter (SLM), octave band analyzer (OBA), and noise dosimeter.

.10 Explain the difference between Type 0, 1, and 2 SLMs and the difference between slow and fast meter responses.

.11 Discuss the following settings of a noise dosimeter: (1) exchange rate, (2) criterion level, (3) meter response, and (4) weighting scale. State the criteria used by the Navy.

.12 Explain the difference between the A, C, and Z or flat weighting scales.

.13 Discuss the use of an OBA and state the center frequencies.

.14 Describe the procedures to certify an audiometric test booth using a Type 1 SLM equipped with an OBA.

.15 Discuss the noise (continuous, intermittent, impact, and impulse) criteria for the designation of hazardous noise areas and equipment, as well as the use of hearing protection devices (HPDs).

.16 Discuss noise hazard radius and sound level (noise) contour mapping.

.17 State the different types of engineering controls, work practices, and administrative controls to eliminate or reduce noise exposures.

.18 Define single and double hearing protection.

.19 Discuss the noise exposure criteria for inclusion of workers in the medical surveillance component (e.g., audiogram) of the Navy's Hearing Conservation Program.

.20 Discuss when pregnant women should be removed from noise hazardous areas.

.21 Explain the noise equations found in Attachment (A) of this standard.

.22 Discuss how to use 3M™ Detection Management Software (DMS), correctly fill out the NMCPHC noise survey forms, and assign laboratory analytical report (LAR) numbers.

Section II: Practicals

107.23 Collect direct noise readings of noise-producing equipment under the supervision of an experienced industrial hygienist or technician. This is to include:

(1) Selecting sound level meter and microphone. _____ Date completed

(2) Calibrating meter. _____ Date completed

(3) Setting parameters. _____ Date completed

(4) Completing survey form. _____ Date completed

(5) Assigning LAR number. _____ Date completed

_____
Certifier name and signature

.24 Conduct personal noise dosimetry under the supervision of an experienced industrial hygienist or technician. This is to include:

(1) Calibrating dosimeter. _____ Date completed

(2) Setting parameters. _____ Date completed

(3) Downloading raw data. _____ Date completed

(4) Completing survey form. _____ Date completed

(5) Assigning LAR number. _____ Date completed

_____
Certifier name and signature

.25 Perform an octave band analysis inside an audiometric test booth under the supervision of an experienced industrial hygienist or technician. This is to include:

(1) Selecting sound level meter and microphone. _____
Date completed

(2) Calibrating meter. _____
Date completed

(3) Setting parameters. _____
Date completed

(4) Completing certificate form. _____
Date completed

_____
Certifier name and signature

Section III: Problem Solving

107.26 The carpenters at the wood shop plan to operate a table saw (90 dB), jointer (96 dB), planar (99 dB), and air compressor (85 dB). All these activities will take place simultaneously. Predict the overall sound pressure (dB) level using the short-cut method.

.27 Four identical grinders will be installed in a metal shop. The sound pressure level emitted 6 feet away from each machine is 83 dB. Calculate the overall sound pressure level (dB) in the shop with all grinders operating simultaneously. Assume these are the only sound sources inside the shop.

.28 The average sound pressure measured 10 feet away from an aircraft is 126 dB. Calculate the sound pressure level (dB) at 100 feet away from the aircraft. Assume free field conditions.

.29 An operator who is sitting 2 feet away from a generator is exposed to constant sound pressure level of 98 dB. Calculate the distance (in feet) away from the generator to reduce his/her exposure to 84 dB. Assume free field conditions.

.30 A supervisor on the shop floor is exposed to a continuous sound pressure level of 92 dB(A). Calculate his/her allowable exposure time (in minutes) for an 8-hour workday using the Navy OEL criteria.

Scenario. A noise survey was conducted for a Sailor performing corrosion control aboard a ship. This process is performed on a quarterly basis. The results of his/her exposure are below. Solve problems .30 through .33.

Duration (hours)	Sound Pressure Level (dBA)
3	82
1	97
2	65
2	91

.31 Calculate his/her noise dose (%) using the Navy OEL criteria.

.32 Calculate his/her 8-hour TWA equivalent exposure (dBA) using the Navy OEL criteria.

.33 Evaluate the compliance of the above exposure against the Navy OEL.

.34 Determine if the exposure frequency and intensity necessitates worker inclusion in the Navy's Medical Surveillance Program (Noise 503 via Medical Matrix).

- END OF 107 -

108 NON-IONIZING RADIATION

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.23 Series. Non-ionizing Radiation, Chapter 22. Navy Safety and Occupational Health Program Manual, July 2011.
B. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Ultraviolet Radiation, Chapter 11. Navy and Marine Corps Public Health Center.
C. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.
D. The Occupational Environment: Its Evaluation, Control, and Management. Nonionizing Radiation, Chapter 22. In S. R. DiNardi (2nd Edition). American Industrial Hygiene Association, 2003.

Section I: Fundamentals

108.01 Explain the difference between ionizing radiation and non-ionizing radiation.

.02 State the Navy's policy on non-ionizing radiation exposure.

.03 Discuss the following characteristics of the electromagnetic (EM) spectrum: (1) wavelength, (2) frequency, and (3) photon energy.

.04 Discuss the common sources and biological effects/target organs for the following EM regions: (1) radio-frequency (RF), (2) microwave (MW), (3) infrared (IR), (4) visible, and (5) ultraviolet (UV).

.05 Describe the three general guidelines for controlling exposure to EM radiation.

.06 Discuss the use of a light meter and the following key concepts associated with illumination: (1) luminance, (2) luminance contrast, and (3) illuminance.

.07 Discuss the following terms in the context of RF/MW radiation: (1) power density, (2) averaging time, (3) controlled and uncontrolled environments, (4) pulsed field, and (5) specific absorption rate (SAR).

.08 Identify the spectral bands and wavelengths for IR, visible, and UV regions (optical radiation) and their target portions (corneal, retinal, or lens) of the eye.

.09 Discuss the Navy's Laser Safety Hazard Control Program and the different classes of lasers, including their hazards and relevant precautions.

.10 Define the following laser terms: (1) nominal ocular hazard distance (NOHD), (2) nominal hazard zone (NHZ), and (3) optical density (OD).

Section II: Practicals

108.11 Perform an illumination survey using a light meter under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

- END OF 108 -

June 20, 2020

109 ERGONOMICS

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.23 Series. Ergonomics Program, Chapter 23. Navy Safety and Occupational Health Program Manual, July 2011.
B. NIOSH Ergonomic and Musculoskeletal Disorders. National Institute for Occupational Safety and Health, 2018.
C. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.
D. Medical Surveillance Procedures Manual and Medical Matrix (12th Edition), Technical Manual NMCPHC-TM OM 6260. Navy and Marine Corps Public Health Center, August 2015.
E. Reproductive and Developmental Hazards: A Guide for Occupational Health Professionals, Technical Manual NMCPHC-TM-OEM 6260.01D. Navy and Marine Corps Public Health Center, May 2019.

Section I: Fundamentals

109.01 Define ergonomics and discuss what is meant by “fitting the workplace to the worker.”

.02 Discuss the following physical risk factors and state examples found in the workplace: (1) force, (2) repetition, (3) awkward and static postures, (4) vibration, and (5) contact stress.

.03 Define work-related musculoskeletal disorder (WMSD) and discuss the following disorders: (1) carpal tunnel syndrome, (2) tendonitis, (3) “trigger finger,” and (4) “white finger” or “Raynaud’s phenomenon.”

.04 State a few contributing factors (occupational and non-occupational) to WMSDs.

.05 Discuss the use of an accelerometer to measure hand-arm vibration (HAV) and whole-body vibration.

.06 Explain the relationship between exposure time and acceleration for HAV based on ACGIH TLV.

.07 Identify a few control methods (engineering, work practices, administrative, and personal protective equipment) to prevent WMSDs.

.08 Identify two WMSDs included in the Navy's Medical Surveillance Program.

.09 Identify who is required to receive general ergonomics training and how often.

Section II: Practicals

109.10 Conduct ergonomic assessments using the Physical Risk Factor Ergonomic and Computer Workstation Checklists found in Appendix 23-A and 23-B, respectively, of OPNAVINST 5100.23G CH-1 under the supervision of an experienced industrial hygienist.

_____ _____
Certifier name and signature Date completed

.11 Measure hand-arm or whole body vibration of a worker using an accelerometer under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

109.12 The measured acceleration of a worker's hand-arm vibration (HAV) when operating a needle gun is 12 m/sec^2. Calculate his/her allowable daily exposure time (in minutes) for an 8-hour workday based on the ACGIH TLV.

- END OF 109 -

June 20, 2020

110 HEAT STRESS

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.19 Series. Heat Stress, Chapter B2. Navy Safety and Occupational Health Program Manual for Forces Afloat, May 2007.
B. NAVMED P-5010-3 Rev 2 Manual of Naval Preventive Medicine. Prevention of Heat and Cold Stress Injuries (Ashore, Afloat, and Ground Forces), Chapter 3. Bureau of Medicine and Surgery, February 2009.
C. OSHA Technical Manual. Heat Stress, Section III, Chapter 4. Occupational Safety and Health Administration.
D. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.
E. NEHC-TM-OEM 6260.6A Prevention and Treatment of Heat and Cold Stress Injuries, June 2007.

Section I: Fundamentals

110.01 Explain the difference between heat stress and heat strain.

.02 Discuss the following sources of heat to the body: (1) radiation, (2) convection, (3) conduction, and (4) metabolic rate.

.03 Discuss the following heat illnesses and injuries: (1) heat rash, (2) heat syncope, (3) heat cramps, (4) heat fatigue, (5) heat exhaustion, and (6) heat stroke.

.04 Define the following types of temperatures: (1) dry bulb (DB), (2) wet bulb (WB), and (3) globe (GT).

.05 Discuss the equations used to calculate the wet bulb globe temperature (WBGT) index for indoor and outdoor environments.

.06 Discuss how to operate and collect WBGT index using a WBGT meter.

.07 Discuss the use of the psychrometric chart to determine DB and WB temperatures, relative humidity, vapor pressure, and dew point.

.08 Discuss the ACGIH decision making process, clothing-adjustment factors, metabolic rate categories, and work/rest cycles for heat stress.

.09 Explain the physiological heat exposure limit (PHEL) curves and stay times aboard a ship.

.10 Identify the types of controls to prevent heat stress and explain how acclimation can be achieved.

.11 Discuss factors which make employees more susceptible to heat illnesses and injuries.

Section II: Practicals

110.12 Perform a heat stress survey for an indoor or outdoor environment using a WBGT meter and complete the appropriate survey form under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

Scenario. An initial heat stress screening was conducted for an acclimated security guard standing watch at an entry control point (ECP) on the pier during a warm, sunny day. He/She was wearing his/her Navy Working Uniform (NWU) and standing (with minimal movement) directly out in the sun. The average temperature (in Fahrenheit) readings taken at the ECP are below. Solve problems .12 through .15 using ACGIH criteria.

Wet Bulb (°F)	Globe (°F)	Dry Bulb (°F)
78.3	102.4	93.6

110.13 Calculate the WBGT exposure in Celsius (°C).

.14 Determine if the WBGT exposure needs to be adjusted for clothing worn.

.15 Classify the Sailor's metabolic activity.

.16 Determine the recommended allocation of work in a work/rest cycle for the Action Limit and TLV.

Scenario. A heat stress survey was performed on culinary specialists washing dishes inside the scullery of a ship. No fuel combustion vapors are present inside this space. The average temperature (in Fahrenheit) readings taken inside the scullery are below. Solve problems .16 through .18 using Chapter B2 of OPNAVINST 5100.19E.

Wet Bulb (°F)	Globe (°F)	Dry Bulb (°F)
81.5	95.2	91.8

.17 The WBGT outdoor equation is used inside the ship. Calculate the WBGT index in Fahrenheit (°F).

.18 Classify the physiological heat exposure limit (PHEL) curve for this space.

.19 Determine the PHEL stay time for scullery personnel on routine watch.

- END OF 110 -

June 20, 2020

111 BLOODBORNE PATHOGENS

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.23 Series. Bloodborne Pathogens, Chapter 28. Navy Safety and Occupational Health Program Manual, July 2011.
B. Code of Federal Regulations, Title 29, Part 1910.1030. Bloodborne Pathogens. Occupational Safety and Health Administration, 2012.
C. Bloodborne Pathogen Exposure Control, Technical Manual NHCPHC-TM-OEM 6260.7. Navy and Marine Corps Public Health Center, November 2010.

Section I: Fundamentals

111.01 State the different types of bloodborne pathogens (BBPs) that are most commonly involved in occupational transmission.

.02 Identify the routes of exposures to BBPs.

.03 Discuss a few activities and practices associated with exposure to BBPs.

.04 Discuss the following infection controls to BBPs: (1) engineering, (2) administrative, (3) work practices, (4) barriers, (5) housekeeping, and (6) hygiene.

.05 Define “universal precaution.”

.06 Discuss Exposure Control Plans (ECPs), plan development participants, and ECP review requirements

Section II: Practicals

None

Section III: Problem Solving

None

- END OF 111 -

June 20, 2020

112 INDOOR ENVIRONMENTAL QUALITY

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.23 Series. Indoor Air Quality Management, Chapter 30. Navy Safety and Occupational Health Program Manual, July 2011.
B. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Indoor Environmental Quality, Chapter 13. Navy and Marine Corps Public Health Center.
C. OSHA Technical Manual. Indoor Air Quality Investigation, Section III, Chapter 2. Occupational Safety and Health Administration.
D. ASHRAE Standard 62.1-2019. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 2019.
E. Mold Information and Resources. Industrial Hygiene General Products and Services. Navy and Marine Corps Public Health Center.

Section I: Fundamentals

112.01 Define “acceptable” indoor air quality and explain the difference between the two sources of indoor air contamination—interior air versus exterior air.

.02 Discuss a few indoor environmental quality (IEQ) concerns such as sick building syndrome, building-related illness, or other (e.g., allergies) categories.

.03 Describe the three step IEQ investigation approach recommended in the NMCPHC Industrial Hygiene Field Operations Manual.

.04 Discuss using team approach as it relates to IEQ investigations and identify other professional SMEs that might be included to ensure a successful investigation.

.05 Identify potential sources to the following IEQ issues: (1) poor air distribution, (2) temperature and humidity extremes, (3) off-gas chemicals, (4) combustion products, and (5) biological contaminants (e.g., mold).

.06 Identify the types of screening instruments used to detect and measure the following indoor contaminants/conditions: (1) volatile organic compounds (VOCs), (2) particulates, and (3) temperature and relative humidity.

.07 Discuss how to calibrate, operate, and collect IEQ data (e.g., carbon monoxide, carbon dioxide, and particulate matter) using direct reading instruments.

.08 Explain where to find indoor air contaminant guidelines and recommendations for Navy non-industrial workspaces.

.09 Discuss how HVAC systems operate to include air handlers, fans, ducts, return air, supply air diffusers, exhaust air grilles, etc.

.10 Discuss a few IEQ remediation techniques to reduce or eliminate air contaminate levels (e.g., VOCs and nuisance dust).

.11 Discuss how to measure supply and exhaust air and how to calculate the number of air changes per hour (ACH) inside a room.

.12 Discuss the prevalence of mold in the environment and the challenges of keeping fungi from entering indoor workplaces.

.13 Identify a few notable mold genera.

.14 Define fungal spores, mycotoxins, and “black mold.”

.15 Discuss the health symptoms and risks associated with mold exposure and why there are no airborne health standards published by regulatory agencies.

.16 Explain the importance of risk communication to building occupants in regards to mold complaints.

.17 Discuss the following basic requirements for mold growth: (1) moisture, (2) food, and (3) temperature.

.18 Discuss the following indicator measurements for mold contamination: (1) visual, (2) odor, (3) temperature, (4) relative humidity, (5) moisture, (6) ventilation, and (7) room pressure.

.19 Explain when it is appropriate to sample for mold.

.20 Discuss the types of viable and non-viable samples (air, bulk, and surface) and sampling methods used to collect mold or spores.

.21 Discuss a few IEQ remediation techniques to reduce or eliminate air contaminate levels (e.g., VOCs and nuisance dust).

.22 Discuss the interpretation criteria for mold sampling results.

.23 Discuss cleaning and remediation techniques for mold and state the recommended personal protective equipment (PPE) for remediation personnel.

Section II: Practicals

112.24 Accompany an experienced industrial hygienist during an IEQ investigation.

_____ _____
Certifier name and signature Date completed

.25 Measure indoor climate conditions (e.g., temperature, relative humidity, carbon dioxide, and airborne particles) using indoor air quality meters under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

.26 Conduct atmospheric testing for combustible/toxic gases using a photoionization detector (PID) under the supervision of an experienced industrial hygienist or technician. This is to include:

(1) Calibrating PID with calibration gas. _____
Date completed

(2) Using response curves/conversion charts. _____
Date completed

(3) Completing survey form. _____
Date completed

_____
Certifier name and signature

.27 Accompany an experienced industrial hygienist during a mold investigation.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

- END OF 112 -

113 INDUSTRIAL VENTILATION

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2 Rev. C. Ventilation, Chapter 6. Navy and Marine Corps Public Health Center, June 2019.
B. Industrial Ventilation: A Manual of Recommended Practice for Design (30th Edition). American Conference of Governmental Industrial Hygienists, 2019.
C. Code of Federal Regulations, Title 29, Part 1910.94. Ventilation. Occupational Safety and Health Administration, 2009.
D. NAVSEA 0938-LP-018-0010. Heating, Ventilation, and Air Conditioning Design Criteria Manual for Surface Ships of the United States Navy. Naval Sea Systems Command.
E. ASHRAE Standard 170-2017. Ventilation of Health Care Facilities. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 2017.

Section I: Fundamentals

113.01 Discuss the following types of ventilation: (1) local exhaust, (2) general (or dilution), and (3) natural.

.02 Describe the following general categories to Navy SOH ventilation standards: (1) general comfort, (2) health, (3) fire and explosion, and (4) special conditions.

.03 Define the following characteristics of pressure within a ventilation duct: (1) static pressure, (2) velocity pressure, and (3) total pressure.

.04 Explain the following pressure losses in a ventilation duct/system: (1) dynamic losses, (2) friction losses, and (3) total system resistance.

.05 Define the following types of air velocities: (1) capture velocity, (2) face velocity, and (3) transport (duct) velocity.

.06 Describe the relationship between air velocity and velocity pressure.

.07 Discuss the following components of a local exhaust ventilation (LEV) system: (1) hood, (2) duct, (3) fan, and (4) air cleaner.

.08 Describe the following basic types of hoods: (1) enclosing hood, (2) capturing hood, and (3) receiving hood.

.09 Discuss the following types of air cleaning devices: (1) fabric filters, (2) cyclone (centrifugal), (3) wet scrubbers, and (4) electrostatic precipitators.

.10 Explain the difference between supply and exhaust air and how make-up air in a room is obtained, exhausted, or recirculated.

.11 Explain the difference between cross draft and downdraft ventilation, as well as cross-sectional area versus floor area of a booth.

.12 Define lower explosive limit (LEL) and upper explosive limit (UEL).

.13 Discuss the use of the following instruments to evaluate ventilation systems: (1) manometer and pitot tube, (2) aneroid gauge, (3) velometer, (4) balometer, (5) anemometer, and (6) smoke tube.

.14 Discuss the general method used to measure the volumetric flowrate (Q) of a ventilation system.

.15 State the minimum airflow velocities for the following ventilation systems: (1) LEV to capture welding fumes, (2) paint booth to dilute VOC concentrations, and (3) abrasive blasting booth to control metal exposures.

.16 State the minimum airflow for the following ventilation systems: (1) LEV to capture welding fumes, (2) paint booth to dilute VOC concentrations, and (3) abrasive blasting booth to control metal exposures.

.17 Explain the ventilation equations found in Attachment (A) of this standard.

Section II: Practicals

113.18 Measure the airflow of local exhaust ventilation systems using an anemometer or velometer under the supervision of an experienced industrial hygienist or technician. Evaluate the following types of hoods:

(1) Capturing hood _____
Date completed

(2) Canopy hood _____
Date completed

(3) Laboratory hood _____

Date completed

(4) Slot hood _____
Date completed

_____
Certifier name and signature

.19 Measure the airflow of dilution ventilation systems using an anemometer, velometer, or balometer under the supervision of an experienced industrial hygienist or technician. Evaluate the following types of spaces:

(1) Spray paint booth _____
Date completed

(2) Abrasive blasting room _____
Date completed

(3) Isolation room _____
Date completed

(4) IEQ complaint area _____
Date completed

_____
Certifier name and signature

.20 Measure the static pressure of a ventilation system using a manometer and pitot tube under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

.21 Evaluate the air movement and room pressure of an enclosure using smoke tubes under the supervision of an experienced industrial hygienist or technician.

_____ _____
Certifier name and signature Date completed

.22 Collect the following types of ventilation measurements under the supervision of an experienced industrial hygienist or technician:

(1) Duct velocity _____
Date completed

(2) Face velocity _____
Date completed

(3) Capture velocity _____
Date completed

(4) Static pressure _____
Date completed

_____
Certifier name and signature

.23 Calculate the following types of ventilation measurements under the supervision of an experienced industrial hygienist or technician:

(1) Volumetric flowrate (Q) _____
Date completed

(2) Velocity pressure (VP) _____
Date completed

(3) Total pressure (TP) _____
Date completed

(4) Air changes per hour (ACH) _____
Date completed

(5) Room air exchange rate _____
Date completed

_____
Certifier name and signature

Section III: Problem Solving

113.24 The diameter of a round duct is 16 inches. The air velocity at the opening of the hood (face velocity) is 95 feet per minute (fpm). Calculate the volumetric flowrate (Q) in cubic feet per minute (cfm).

.25 The dimensions of a rectangular duct is 6 in x 9 in. The face velocity is 133 fpm. Calculate the volumetric flowrate in cfm.

.26 The average velocity pressure of air flowing through a duct is 0.65 inches of water gauge (in wg). Calculate the air velocity in fpm.

.27 Assume the measurement in problem .25 is made in a round duct with a 12-inch diameter. Calculate the volumetric flowrate in cfm.

.28 Assume the measured static pressure in problem .25 is -3.00 in wg. Calculate the total pressure (in wg).

.29 Determine whether the fan in problem .27 is upstream or downstream of the measurement point.

.30 An airflow of 3,600 cfm is flowing into an 18-inch circular duct. Calculate the capture velocity (fpm) at 2 feet in front of the unflanged open hood.

Scenario. The room dimensions of a paint locker aboard a ship is 15 ft x 12 ft x 8 ft. The flowrates of the two exhaust ducts are 145 cfm and 138 cfm. The flowrate of the supply duct is 304 cfm. NAVSEA requires the room to be under negative air pressure and to have a minimum 4-minute air exchange rate. Solve problems .30 through .32.

.31 Calculate the room air exchange rate in minutes.

.32 Determine if the room is under negative or positive air pressure.

.33 Determine if the ventilation system satisfies the NAVSEA requirements and provide corrective actions (if any).

Scenario. The room dimensions of an isolation ward is 35 ft x 20 ft x 8 ft. The total exhaust flowrate is 792 cfm, and the total supply flowrate is 634 cfm. ASHRAE requires the room to be under negative air pressure and to have a minimum 10 air changes per hour (ACH). Solve problems .33 through .35.

.34 Calculate the ACH inside the ward.

.35 Determine if the room is under negative or positive air pressure.

.36 Determine if the ventilation system satisfies the ASHRAE requirements and provide corrective actions (if any).

- END OF 113 -

114 PERSONAL PROTECTIVE EQUIPMENT

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.19 Series. Personal Protective Equipment, Chapter B12. Navy Safety and Occupational Health Program Manual for Forces Afloat, May 2007.
B. OPNAVINST 5100.23 Series. Personal Protective Equipment, Chapter 20. Navy Safety and Occupational Health Program Manual, July 2011.
C. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Noise Surveys, Chapter 5; Respiratory Protection, Chapter 9; and Personal Protective Equipment and Chemical Protective Clothing, Chapter 10. Navy and Marine Corps Public Health Center.
D. Respiratory Protection Toolbox. Industrial Hygiene General Products and Services. Navy and Marine Corps Public Health Center.
E. Code of Federal Regulations, Title 29, Part 1910.132. Personal Protective Equipment, General Requirements. Occupational Safety and Health Administration, 2011.
F. Code of Federal Regulations, Title 29, Part 1910.133. Eye and Face Protection. Occupational Safety and Health Administration, 2016.
G. Code of Federal Regulations, Title 29, Part 1910.134. Respiratory Protection. Occupational Safety and Health Administration, 2011.
H. Quick Selection Guide to Chemical Protective Clothing. In K. Forsberg and S. Z. Mansdorf (6th Edition). John Wiley and Sons, Inc., 2014.

Section I: Fundamentals

114.01 Discuss the anatomical, contaminant hazard, and environmental factors to consider when selecting the appropriate level of personal protection against workplace stressors.

.02 State the different classes of NIOSH/MSHA-approved respirators and their assigned protection factors (APFs).

.03 Define continuous flow, demand, and pressure demand supplied-air (or airline) respirators.

.04 State the minimum specifications for Grade D compressed breathing air for atmosphere supplying respirators.

.05 Explain how to calculate the maximum use concentration (MUC) of respirators.

.06 State the three classes of particulate filters and discuss their use in different workplace conditions.

.07 Identify the different types of methods used to calculate chemical cartridge change-out schedules.

.08 Discuss qualitative and quantitative respirator fit testing, including user seal checks.

.09 Discuss the maintenance requirements (e.g., cleaning, inspection, and storage) of respirators.

.10 Identify the required elements of a written Respiratory Protection Program.

.11 State the requirements to wear voluntary-use filtering facepiece respirators (disposable dust masks).

.12 Discuss medical evaluations for respirator users per the Navy's Medical Surveillance Program.

.13 Identify the marking requirements for impact and non-impact safety glasses of ANSI Z87.1-2010.

.14 Explain the difference between vented and non-vented chemical splash goggles, as well as the hazards they protect against.

.15 State the OSHA reference used to find the required minimum shade number (optical density) for welders' eye protection against various "hot work" operations.

.16 Discuss the potential hazards from overprotecting with chemical protective clothing (CPC).

.17 Define the following terms as they pertain to chemicals coming in contact with CPC: (1) breakthrough time, (2) permeation, (3) degradation, and (4) penetration.

.18 Discuss the advantages and disadvantages of using the following types of chemical protective gloves: (1) nitrile, (2) butyl, (3) neoprene, (4) Viton™, (5) polyvinyl chloride (PVC), and (6) latex.

.19 State the different types of hearing protection devices (HPDs) used to protect against hazardous noise.

.20 Identify the proper hearing protection for noise levels (continuous and intermittent) greater than 85 dB(A) and 104 dB(A) when double hearing protection is required.

.21 Define an HPD's noise reduction rating (NRR) and discuss how to calculate the derated NRR.

Section II: Practicals

114.22 Accompany an experienced industrial hygienist to observe a shop performing respirator fit testing. Evaluate the two test methods listed.

(1) Quantitative _____
Date completed

(2) Qualitative _____
Date completed

_____
Certifier name and signature

.23 Accompany an experienced industrial hygienist to observe a shop collecting a quarterly Grade D compressed breathing air sample for supplied-air respirators (SARs) or self-contained breathing apparatuses (SCBAs).

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

114.24 Calculate the maximum use concentration (MUC) in mg/m^3 for a half-mask, air-purifying respirator for protection against lead dust based on the OSHA PEL-TWA.

.25 Calculate the MUC in ppm for a continuous flow, supplied-air respirator equipped with a full facepiece for protection against hexamethylene diisocyanate (HDI) based on the ACGIH TLV-TWA.

.26 Calculate the optical density for a welder's eye protection (shade number 10) against UV radiation while performing shielded metal-arc welding.

Scenario. An instructor 8-hour TWA exposure to noise at a firing range was 97.2 dB(A). He/She wore double hearing protection (earplugs and muffs). The noise reduction rating (NRR) of the ear plugs is 29 dB, and the NRR of the ear muffs is 23 dB. Solve problems .27 through .29.

.27 Evaluate the actual effectiveness of his/her hearing protection by calculating the derated NRR for dual hearing protection using the common method by OSHA.

.28 Calculate the sound pressure level (dBA) expected at the ear of the protected instructor.

.29 Evaluate the compliance of the above estimated exposure by comparing to the DoD/Navy OEL.

- END OF 114 -

115 EQUIPMENT MAINTENANCE AND CALIBRATION

Completed: _____ _____
Supervisor Date

Reference:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Equipment Maintenance and Calibration, Chapter 8. Navy and Marine Corps Public Health Center.

Section I: Fundamentals

115.01 Identify the different types of industrial hygiene equipment that can be calibrated at the NMCPHC Calibration Laboratory.

.02 Discuss what types of field maintenance on equipment can be performed by the Industrial Hygiene Department.

.03 Define an “intrinsically safe” instrument.

.04 Explain the actions taken for out-of-tolerance equipment and procedures to send equipment out for calibration.

.05 State the minimum information required in a periodic laboratory calibration record.

.06 Explain the difference between primary and secondary calibration standards for air sampling pumps.

.07 Identify the different types of calibrators used for air sampling pumps.

.08 Discuss when to field calibrate air sampling pumps, sound level meters, and noise dosimeters.

.09 Explain how to field calibrate combustible and toxic gas meters using calibration gas and response curves/conversion charts.

.10 State the laboratory and field calibration periodicity for the following equipment: (1) heat stress monitors, (2) indoor air meters, (3) light meters, (4) noise measuring instruments, and (5) air velocity meters.

.11 Discuss how to track and manage the industrial hygiene equipment both onboard and out for calibration.

Section II: Practicals

115.12 Conduct industrial hygiene equipment inventory under the supervision of an experienced industrial hygiene technician.

_____ _____
Certifier name and signature Date completed

.13 Send industrial hygiene equipment out for calibration under the supervision of an experienced industrial hygiene technician.

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

- END OF 115 -

June 20, 2020

116 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) EXPANDED STANDARDS

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.19 Series. Asbestos Management, Chapter B1 and Lead Control, Chapter B10. Navy Safety and Occupational Health Program Manual for Forces Afloat, May 2007.
B. OPNAVINST 5100.23 Series. Asbestos Control, Chapter 17 and Lead, Chapter 21. Navy Safety and Occupational Health Program Manual, July 2011.
C. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Asbestos Monitoring Procedures, Chapter 7. Navy and Marine Corps Public Health Center.
D. Code of Federal Regulations, Title 29, Part 1910.1001, .1025, .1026, .1027, .1028, .1048, .1052, and .1053. Asbestos, Lead, Chromium (VI), Cadmium, Benzene, Formaldehyde, Methylene Chloride, and Respirable Crystalline Silica (General Industry). Occupational Safety and Health Administration.
E. Code of Federal Regulations, Title 29, Part 1915.1001 and .1025. Asbestos and Lead (Shipyard). Occupational Safety and Health Administration.
F. Code of Federal Regulations, Title 29, Part 1926.62 and .1101. Lead and Asbestos (Construction). Occupational Safety and Health Administration.
G. TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. American Conference of Governmental Industrial Hygienists, 2019.
H. Medical Surveillance Procedures Manual and Medical Matrix (12th Edition), Technical Manual NMCPHC-TM OM 6260. Navy and Marine Corps Public Health Center, August 2015.
I. Casarett and Doull's Toxicology: The Basic Science of Poisons. In C. D. Klaassen (9th Edition). The McGraw-Hill Companies, 2019.

Section I: Fundamentals

116.01 Discuss the following health effects to asbestos exposure: (1) asbestosis, (2) promoter to cancer, (3) relationship with smoking, and (4) latent periods for development of asbestosis and cancer.

.02 Discuss the physical characteristics of the six unique natural mineral fibers that belong to the serpentine and amphibole mineral families and identify the most common used form of asbestos.

.03 Explain the difference between friable and non-friable asbestos-containing material (ACM) and identify the four classes of asbestos work for shipyard and construction.

.04 Explain the physical characteristics of lead particulates and the toxicology, including the routes of exposure.

.05 Discuss the following sources of lead emissions: (1) foundries, (2) firing ranges, (3) abrasive blasting and grinding, (4) welding, (5) soldering, and (6) painting.

.06 Discuss OSHA and Navy regulations associated with asbestos and lead exposures to include: (1) monitoring frequency, (2) employee notification, (3) training, (4) workplace controls, and (5) medical surveillance.

.07 Define silicosis and discuss the key provisions to OSHA's Final Rule to protect workers from exposure to respirable crystalline silica.

.08 Discuss the volatility of benzene (human carcinogen), formaldehyde (dermal and respiratory sensitizer), and methylene chloride (CNS impair), as well as the risks of exposure.

.09 Identify common industrial processes that involve chromium that can result in exposure to hexavalent chromium (human carcinogen).

.10 State the two particle size-selective TLVs for cadmium dust (suspected human carcinogen).

.11 Identify the OSHA substance-specific standards that have short-term exposure limits (STELs) and excursion limits (ELs).

.12 Define "regulated" area and discuss proper hygiene areas/practices, housekeeping, and ventilation to prevent the spread of OSHA substance-specific standards.

.13 Describe the main elements of the Hazardous Communication (HAZCOM) Program for OSHA substance-specific standards.

Section II: Practicals

None

Section III: Problem Solving

None

- END OF 116 -

June 20, 2020

117 NAVY SAFETY AND OCCUPATIONAL HEALTH (SOH) PROGRAMS

Completed: _____ _____
Supervisor Date

References:

A. OPNAVINST 5100.19 Series. Navy Safety and Occupational Health Program Manual for Forces Afloat, May 2007.
B. OPNAVINST 5100.23 Series. Navy Safety and Occupational Health Program Manual, July 2011.

Section I: Fundamentals

117.01 Discuss the major elements of the Hearing Conservation Program (HCP) to include:
(1) employee training,
(2) medical surveillance,
(3) audiograms,
(4) warning signs/labels, and
(5) hearing protectors.

.02 Discuss the major elements of the Respiratory Protection Program (RPP) to include: (1) annual audit, (2) fit testing and training, (3) written SOP, (4) medical surveillance, and (5) storage and maintenance.

.03 Discuss the major elements of the Sight Conservation Program to include: (1) employee training, (2) eyewash stations, (3) hazardous areas/processes, (4) warning signs/labels, and (5) protective eyewear.

.04 Discuss the major elements of the Ergonomics Program to include: (1) employee training, (2) hazard prevention and control, and (3) medical surveillance.

.05 Discuss the major elements of the Hazardous Material Control and Management (HMC&M) Program to include: (1) HAZCOM, (2) safety data sheet (SDS), (3) authorized use list (AUL), and (4) labeling and storage.

.06 Discuss the major elements of the Heat Stress Program (afloat) to include: (1) employee training, (2) heat stress monitoring and surveying, (3) injury reports, and (4) safe work schedules (stay times).

.07 Discuss the major elements of the Lead Program to include: (1) employee training and notification, (2) medical surveillance, (3) workplace control practices, (4) warning signs/labels, and (5) respiratory protection.

.08 Discuss the major elements of the Asbestos Control Program to include: (1) employee training and notification, (2) medical surveillance, (3) workplace control practices, (4) warning signs/labels, and (5) respiratory protection.

.09 Discuss the major elements of the Non-ionizing Radiation (Laser) Program to include: (1) employee training, (2) medical surveillance, (3) inventory, (4) shielding, (5) warning signs/labels, and (6) protective eyewear.

.10 Discuss the major elements of the Occupational Reproductive Hazards Program to include: (1) employee training, (2) medical surveillance, (3) list of reproductive stressors, (4) medical counseling, and (5) controls (e.g., ALARA).

Section II: Practicals

117.11 Accompany an experienced industrial hygienist during a periodic industrial hygiene survey to evaluate the following Navy SOH programs (at least five programs) at a command or shop:

(1) Hearing Conservation _____ Date completed

(2) Respiratory Protection _____ Date completed

(3) Sight Conservation _____ Date completed

(4) Ergonomics _____ Date completed

(5) HMC&M _____ Date completed

(6) Heat Stress _____ Date completed

(7) Lead _____ Date completed

(8) Asbestos Control _____ Date completed

(9) Laser _____ Date completed

(10) Reproductive and Fetal Developmental Hazards

_____
Date completed

_____
Certifier name and signature

Section III: Problem Solving

None

- END OF 117 -

June 20, 2020

118 INDUSTRIAL PROCESS ASSESSMENTS

Completed: _____ _____
Supervisor Date

Reference:

A. Recognition of Health Hazards in Industry. A Review of Materials and Processes. In W. A. Burgess (2nd Edition). John Wiley & Sons, Inc., 1995.

Section I: Fundamentals

118.01 Explain the difference between the following types of welding: (1) shielded metal arc welding (SMAW), (2) gas tungsten arc welding (GTAW), and (3) gas metal arc welding (GMAW).

.02 Identify the chemical of concern when welding stainless steel, nonferrous alloys, chromate coatings, and some welding consumables.

.03 Discuss a few factors, including fume generation rate that affect worker exposures to metal fumes from welding, cutting, and brazing. Identify the types of controls used to minimize potential metal exposures.

.04 Identify the routes of exposure associated with soldering operations using low-temperature soldering irons to apply lead-tin solder and flux to electronic components.

.05 Discuss some good housekeeping and personal hygiene practices to minimize potential lead exposures during soldering operations.

.06 Explain the process of forging. Identify the stressors found in cold/hot forging and the types of controls used to minimize potential exposures.

.07 Explain the process of electroplating. Identify the common plating metals used, the factors that affect the mist generation rate, and the types of controls used to minimize inhalation exposures to toxic metals.

.08 Discuss the potential health hazards associated with machine tools, cutting tools, and machining fluids. Identify the types of controls used to minimize potential exposures to stressors.

.09 Discuss the operations and major components of an abrasive blasting cabinet and room and identify the various types of media used for cleaning.

.10 Discuss the operations and major components of a paint booth and identify the various types of spray systems.

.11 Discuss the potential health hazards to isocyanates commonly found in two-part polyurethane coating systems and hexavalent chromium (corrosion inhibitor) that may exist in the primers.

.12 Discuss the operations and major components of a dust collector and local exhaust ventilation (LEV) system used to capture and collect wood dust created from woodworking.

.13 Identify wood species that are classified as human carcinogens.

.14 Discuss the stressors found in ship breaking and identify the types of controls used to minimize potential exposures.

.15 Discuss the potential health hazards from firing weapons at a shooting range and identify the types of controls used to minimize potential exposures.

.16 Explain why range users (shooters) must be enrolled in the Navy's Hearing Conservation Program.

Section II: Practicals

118.17 Conduct research, site visit, interviews and fact finding, observations, sampling and interpretation of results (if practicable), conclusions and recommendations, and exposure assessment write-ups for the processes listed below (at least five processes) under the supervision of an experienced industrial hygienist. The industrial hygiene technician is only expected to conduct exposure monitoring.

(1) Welding, cutting, and brazing _____
Date completed

(2) Soldering _____
Date completed

(3) Forging _____
Date completed

(4) Electroplating _____
Date completed

(5) Metal machining _____
Date completed

(6) Abrasive blasting _____
Date completed

(7) Spray painting _____
Date completed

(8) Woodworking _____
Date completed

(9) Ship breaking _____
Date completed

(10) Weapons firing _____
Date completed

_____
Certifier name and signature

Section III: Problem Solving

None

- END OF 118 -

June 20, 2020

119 INDUSTRIAL HYGIENE SURVEYS AND REPORTS

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Industrial Hygiene Surveys and Survey Reports, Chapter 2. Navy and Marine Corps Public Health Center.
B. OPNAVINST 5100.23 series.
C. OPNAVINST 5100 19 series.

Section I: Fundamentals

119.01 Explain the difference between BIHS, PIHS, and special industrial hygiene survey.

.02 Describe the three command hazard categories.

.03 Discuss the three types of shop priorities and the periodicity of PIHS.

.04 Discuss the required elements of a BIHS report and a PIHS report.

.05 Discuss the required elements of the worksite evaluation by shop.

.06 Explain the difference between negative and positive determination of an exposure assessment.

.07 Define the criteria for the “required” exposure monitoring and “optional” exposure monitoring and the exposure monitoring strategy for shop with a survey periodicity longer than annually.

.08 Discuss the required and optional command wide summary tables and appendices for BIHS or PIHS.

.09 Explain how to record personal exposure monitoring results in the medical record.

.10 State the time frames to issue BIHS and PIHS reports to the command or shop.

.11 State the minimum retention period of survey, evaluation, and sampling records.

Section II: Practicals

119.12 Complete the writing and review process for each of the following types of survey reports:

(1) BIHS _____
Date completed

(2) PIHS _____
Date completed

(3) Special industrial hygiene survey _____
Date completed

_____ _____
Certifier name and signature Date completed

Section III: Problem Solving

None

- END OF 119 -

June 20, 2020

120 DOEHRS-IH
DEFENSE OCCUPATIONAL AND ENVIRONMENTAL HEALTH READINESS SYSTEM – INDUSTRIAL HYGIENE (DOEHRS-IH) APPLICATION

Completed: _____ _____
Supervisor Date

References:

A. Industrial Hygiene Field Operations Manual, Technical Manual NMCPHC-TM 6290.91-2. Exposure Assessment Strategies, Chapter 4 and Sampling Procedures, Chapter 3, Appendix 3-A-3. Navy and Marine Corps Public Health Center.
B. DOEHRS Student Guide/User Manual, Defense Health Services Systems.
C. BUMEDINST 5100.13 series

Section I: Fundamentals

120.01 After attending the basic DOEHRS-IH course, review supplemental materials on the NMCPHC DOEHRS-IH webpage.

.02 Discuss the eight steps of the DoD industrial hygiene exposure assessment model.

.03 Discuss adding an organization with a unit identification code (UIC to an industrial hygiene program office.

.04 Discuss entering a shop to an organization.

.05 Discuss adding personnel to a shop.

.06 Discuss adding processes to a shop.

.07 Discuss adding hazards to processes.

.08 Discuss adding shop personnel to processes.

.09 Discuss adding controls to processes.

.10 Discuss adding shop equipment to a process.

.11 Discuss entering sound level measurements for shop equipment to a process.

.13 Discuss adding shop/processes, process hazards and process personnel to a SEG

.14 Discuss adding personal air and noise dosimetry results to SEGs.

.15 Discuss calculating TWAs for personal air sampling and noise dosimetry.

.16 Discuss selecting the appropriate OELs and performing industrial hygiene assessments for SEG shop/process hazards.

.17 Discuss performing ergonomic assessments for SEG shop/process hazards.

.18 Discuss performing quality assurance (QA) of personal sampling results, TWAs, and assessments.

Section II: Practicals

120.19 Enter or edit the following information into DOEHRS-IH under the supervision of an experienced industrial hygienist:

(1) Shops _____ Date completed

(2) Shop personnel _____ Date completed

(3) Processes _____ Date completed

(4) Hazards _____ Date completed

(5) Process personnel _____ Date completed

(6) Controls _____ Date completed

(7) Shop equipment _____ Date completed

(8) Shop equipment sound levels _____
Date completed

_____ _____
Certifier name and signature Date completed

.20 Create SEGs or edit existing SEGs and assign the following information under the supervision of an experienced industrial hygienist:

(1) Shop / Processes _____
Date completed

(2) Hazards _____
Date completed

(3) SEG personnel _____
Date completed

_____ _____
Certifier name and signature Date completed

.21 Enter the following personal sampling results under the supervision of an experienced industrial hygienist or industrial hygiene technician:

(1) Air sampling _____
Date completed

(2) Noise dosimetry _____
Date completed

_____ _____
Certifier name and signature Date completed

.22 QA the following personal sampling results under the supervision of an experienced industrial hygienist:

(1) Air sampling _____
Date completed

(2) Noise dosimetry _____
Date completed

_____ _____
Certifier name and signature Date completed

.23 Calculate the TWAs and select the appropriate occupational exposure limits (OELs) for the following personal sampling results under the supervision of an experienced industrial hygienist

(1) Air sampling _____
Date completed

(2) Noise dosimetry _____
Date completed

_____ _____
Certifier name and signature Date completed

.24 QA the following personal sampling result TWAs under the supervision of an experienced industrial hygienist:

(1) Air sampling _____
Date completed

(2) Noise dosimetry _____
Date completed

_____ _____
Certifier name and signature Date completed

.25 Perform qualitative and quantitative (using appropriate exposure assessment statistics) SEG assessments, as appropriate, for the following types of hazards under the supervision of an experienced industrial hygienist:

(1) Chemical (inhalation and contact) _____
Date completed

(2) Noise _____
Date completed

(3) Ergonomics _____
Date completed

_____ _____
Certifier name and signature Date completed

.26 QA the following assessments under the supervision of an experienced industrial hygienist:

(1) Chemical (inhalation and contact) _____
Date completed

(2) Noise _____
Date completed

(3) Ergonomics _____
Date completed

Section III: Problem Solving

None

- END OF 120 -

June 20, 2020

Attachment A:
BASIC INDUSTRIAL HYGIENE EQUATIONS

AIR SAMPLING

Actual TWA (Single Contaminant)

$$TWA_{actual} = \frac{C_1(T_1) + C_2(T_2) + \ldots + C_n(T_n)}{T}$$

TWA = time weighted average concentration
C = concentration of airborne contaminants
T = exposure time

8-hour TWA (Single Contaminant)

$$TWA_{8\text{-hour}} = \frac{C_1(T_1) + C_2(T_2) + \ldots + C_n(T_n)}{480 \text{ minutes (or 8 hours)}}$$

TWA = time weighted average concentration
C = concentration of airborne contaminants
T = exposure time

OEL for Mixtures (Additive Effects)

$$K = \frac{C_1}{OEL_1} + \frac{C_2}{OEL_2} + \ldots + \frac{C_n}{OEL_n}$$

K = if computed value is >1, OEL is exceeded.
C = time weighted average concentration
OEL = occupational exposure limit

Adjusted OEL (Unusual Work Shifts)

$$OEL_{adjusted} = OEL\left(\frac{8}{h} \times \frac{24 - h}{16}\right)$$

* Brief and Scala model for work weeks of less than 7 days.
OEL = occupational exposure limit
8 = number of hours per traditional workday
h = number of hours worked per day
24 = number of hours per day
16 = number of recovery hours per workday

Concentration of Contaminants

$$\frac{mg}{m^3} = \frac{\text{mass of particulate}}{\text{volume of air sampled}}$$

$$ppm = \frac{\text{volume of gas or vapor}}{\text{volume of air sampled}} \times 10^6$$

Conversion of ppm to mg/m^3

$$\frac{mg}{m^3} = \frac{ppm \times MW}{24.45}$$

mg/m^3 = milligrams per cubic meter
ppm = parts per million
MW = molecular weight

Conversion of mg/m^3 to ppm

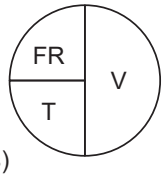
$$ppm = \frac{mg/m^3 \times 24.45}{MW}$$

ppm = parts per million
mg/m^3 = milligrams per cubic meter
MW = molecular weight

Sample Volume and Time

$V = FR \times T$

$T = \frac{V}{FR}$



V = volume (liters)
FR = flowrate (liters per minute)
T = time (minutes)

Minimum Sample Volume

$$V_{min} = \frac{LOQ}{OEL\ (mg/m^3) \times DF\ of\ OEL}$$

V_{min} = minimum sample volume (liters)
LOQ = analytical limit of quantitation (µg)
DF = desired fraction
OEL = occupational exposure limit

Conversion of Liters to Cubic Meters (m^3) or Total Volume Sampled in m^3

1 m^3 = 1000 liters (L)

$? \ m^3 = liters \times \frac{m^3}{1000\ L}$

Conversion of Micrograms (µg) to Milligrams (mg)

$$\mu g \times \frac{1000\ mg}{1 \times 10^6\ \mu g} = mg$$

Percent Error

$$\%\ error = \frac{FR\ pre\text{-}cal - FR\ post\text{-}cal}{FR\ pre\text{-}cal} \times 100$$

FR = flowrate
Pre-cal = pre-calibration
Post-cal = post-calibration
* Percent error is always positive.

Conversion Factors for Metal Scan Concentrations

Iron (Fe_2) to Iron Oxide (Fe_2O_3):

CF = MW of Fe_2O_3 / MW of Fe_2
CF x Fe_2 concentration (mg/m^3) = Fe_2O_3

Zinc (Zn) to Zinc Oxide (ZnO):

CF = MW of ZnO / MW of Zn
CF x Zn concentration (mg/m^3) = ZnO

Vanadium (V_2) to Vanadium Pentoxide (V_2O_5):

CF = MW of V_2O_5 / MW of V_2
CF x V_2 concentration (mg/m^3) = V_2O_5

CF = conversion factor
MW = molecular weight

NOISE

DoD Occupational Exposure Limits

3 decibel (dB) exchange rate.

Sound Level (dBA)	Duration (hour/day)
80	24
82	16
85	8
88	4
91	2
94	1
97	0.5
100	0.25
…	…
139	0.11 (seconds)

$T = 8 \times 2^{(85 - Lp) / 3}$

dB(A) = decibel (A-weighted)
T = allowable exposure time (hours)
Lp = sound pressure level (dBA)

Combining Identical Sound Pressure Levels

$Lp_f = Lp_i + 10 \log (n)$

Lp_f = final sound pressure level
Lp_i = sound pressure level of identical sources
n = number of sources

Adding Sound Pressure Levels (Short-cut Method)

Difference in Decibel Values	Add to Higher Value
0 - 1 dB	3 dB
2 - 4 dB	2 dB
5 - 9 dB	1 dB
≥10 dB	0 dB

Distance from Noise Source (Sound Pressure Level)

$$Lp_2 = Lp_1 + 20 \log d_1 / d_2$$

Lp_2 = final sound pressure level
Lp_1 = initial sound pressure level
d_1 = initial distance from source
d_2 = final distance from source
* For every doubling of distance from a source, the sound pressure level will decrease 6 dB.

Combining Sound Pressure Levels to Determine Noise Dose

$$D = 100 \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots + \frac{C_n}{T_n} \right)$$

D = total noise dose (percent)
C = exposure time at particular sound level
T = total time allowed at that sound level

Dose to Equivalent TWA (DoD OEL)

$$TWA_{actual} = 10 \times \log \frac{D}{12.5 + T} + 85 \text{ dB(A)}$$

$$TWA_{8\text{-hour}} = 10 \times \log \frac{D}{100} + 85 \text{ dB(A)}$$

TWA = time weighted average exposure (dBA)
D = total noise dose (percent)
T = exposure time (hours)

HAND-ARM VIBRATION (HAV)

$$t_{exp} = 8h \left(\frac{5 \text{ ms}^2}{a_{measured}} \right)^2$$

t_{exp} = allowable exposure time (hours)
8h = 8-hour energy equivalent total value
5 ms^2 = acceleration TLV (meters/sec^2)
$a_{measured}$ = measured acceleration (meters/sec^2)

HEAT STRESS

Wet Bulb Globe Temperature (WBGT)

With direct exposure to sunlight:

$$WBGT_{out} = 0.7 \text{ WB} + 0.2 \text{ GT} + 0.1 \text{ DB}$$

Without direct exposure to sunlight:

$$WBGT_{in} = 0.7 \text{ WB} + 0.3 \text{ GT}$$

WB = wet-bulb temperature
GT = globe temperature
DB = dry-bulb (air) temperature

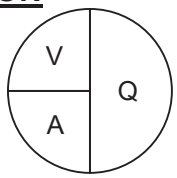
Temperature Conversion

$^oF = 1.8^oC + 32$ ^oF = Fahrenheit, ^oC = Celsius

$$^oC = \frac{^oF - 32}{1.8}$$

INDUSTRIAL VENTILATION

Volumetric Flowrate



$Q = VA$

Q = volumetric flowrate (ft^3/min)
V = linear air velocity (ft/min)
A = cross sectional area of the duct or opening at the point of measurement (ft^2)

Capture Velocity

Unflanged Open Hood:

$Q = V_x (10x^2 + A_f)$
Aspect Ratio of W/H must be ≥ 0.2 or round

Flanged Open Hood:

$Q = 0.75 \times V_x (10x^2 + A_f)$
Aspect Ratio of W/H must be ≥ 0.2 or round

Q = volumetric flowrate (ft^3/min)
V_x = velocity at distance x (ft/min)
x = distance from hood face (ft)
A_f = area of hood face (ft^2) = Width x Height

Room Air Exchange Rate

$$N = \frac{R_v}{Q}$$

N = number of minutes that it takes to exhaust a volume of air equal to the volume of the room.
R_v = room volume (ft^3)
Q = volumetric flowrate (ft^3/min)

Number of Air Changes in a Room

$$N = \frac{Q \times 60 \text{ min}}{R_v}$$

N = number of air changes per hour (ACH)
Q = volumetric flowrate (ft^3/min)
R_v = room volume (ft^3)

General Velocity

$$V = 4005\sqrt{vp}$$

V = air velocity (ft/min)
vp = velocity pressure (in wg)

Total Pressure

$$TP = SP + VP$$

TP = total pressure (in wg), + / -
SP = static pressure (in wg), + / -
VP = velocity pressure (in wg), always +

Conversion of Square Inches (in^2) to Square Feet (ft^2)

$$in^2 \times \frac{ft^2}{144\ in^2} = ft^2$$

PERSONAL PROTECTIVE EQUIPMENT

Hearing Protection Devices (HPDs)

Estimating HPD attenuation (OSHA common method):

dB(C): TWA - (NRR x 0.5)
dB(A): TWA - ((NRR - 7) x 0.5))

dB(C) = decibel (C-weighted)
dB(A) = decibel (A-weighted)
TWA = time weighted average exposure
NRR = noise reduction rating (dB)

Double hearing protection (earplugs and muffs):

HPD attenuation = higher derated NRR + 5 decibels (dB)

HPD = hearing protection device
NRR = noise reduction rating (dB)

Respiratory Protection

MUC = APF x OEL

MUC = maximum use concentration
APF = assigned protection factor
OEL = occupational exposure limit

UV Protective Eyewear

SN = 1 + (7/3 x OD)

SN = shade number
OD = optical density

GEOMETRIC FIGURES

Circle Formulas

$A = \pi r^2$
$C = \pi D$
$D = C / \pi$
$r = D / 2$

A = area
C = circumference
D = diameter
r = radius
$\pi = 3.14$

Area (A)

Square: A = (side) (side)
Rectangle: A = (length) (width)
Circle: $A = \pi$ (radius)^2

Volume (V)

Cube: V = (side) (side) (side)
Carton: V = (length) (width) (height)
Cylinder: V = π (radius)^2 (height)

METRIC CONVERSION FACTORS

1 meter (m) = 3.281 feet (ft)
1 foot (ft) = 30.48 centimeters (cm)
1 inch (in) = 2.54 centimeters (cm)
1 gallon (gal) = 3.785 liters (l)
1 liter (l) = 1.057 quarts (qt)
1 cubic feet (ft^3) = 28.32 liters (l)
1 cubic inch (in^3) = 16.39 milliliters (ml)
1 fluid ounce (fl oz) = 29.57 milliliters (ml)

June 20, 2020

METRIC UNIT OF MEASUREMENTS

Length

1 meter (m) = 100 centimeters (cm) = 1000 millimeters (mm)
1 centimeter (cm) = 10 millimeters (mm)
1 micron (µm) = 10^{-4} centimeters (cm)

Volume

1 liter (l) = 1000 milliliters (ml) = 1000.027 cubic centimeters (cc)

Mass

1 kilogram (kg) = 1000 grams (g)
1 gram (g) = 1000 milligrams (mg) = 10^{6} micrograms (µg)

SIGNIFICANT FIGURES

(1) In any approximate number, the significant digits include the digit that determines the degree of precision of the number and all digits to the left of it, except for zeros left to replace the zero.
(2) All digits from 1 to 9 are significant.
(3) All zeros that are between significant digits are significant.
(4) Final zeros of decimal numbers are significant.

Published By

NAVY AND MARINE CORPS PUBLIC HEALTH CENTER (NMCPHC)
620 John Paul Jones Circle, Suite 1100
Portsmouth, VA 23708-2103

Prepared by

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