DEPARTMENT OF THE AIR FORCE
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BIOENVIRONMENTAL ENGINEERING

Sampling Overview

QUALIFICATION TRAINING PACKAGE

Accessibility: ***Publications and forms are available on the e-publishing website at http://www.e-publishing.af.mil for downloading or ordering.***

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STS Line Item 4.5.1.3: Prepare and/or preserve samples for shipment

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step by step procedures for doing the task.
Prerequisites:	None
Training References:	• Installation Environmental Sampling, Analysis and Monitoring (ESAM) Plan, if available. • *USAFSAM Laboratory Sampling Guide*, https://hpws.afrl.af.mil/dhp/OE/ESOHSC/
Additional Supporting References:	• *International Air Transport Association , Dangerous Goods Regulations*, 55th edition, *Department of Labor (DOT)*, http://www.dol.gov/ • Standard Methods, 22nd Edition, Part 1060 B & C
CDC Reference:	4B051
Training Support Material:	• Samples • Shipping containers • Packing material • Labels • Ice • Tape • Sample analysis request forms • Chain of custody forms
Specific Techniques:	Conduct hands-on training and evaluation.
Criterion Objective:	Given sample(s), shipping supplies, and references, prepare and ship sample(s) successfully completing all checklist items with limited trainer assistance on only the hardest parts.
Notes: None	

TASK STEPS

1. Utilize USAFSAM Laboratory Sampling Guide[1] and coordinate sample analysis with servicing laboratory.
2. Ensure samples are preserved and stored properly according to USAFSAM Laboratory Sampling Guide[1], the local ESAM Plan, State, or servicing laboratory guidance for each type of sample collected.[2]
3. Tighten all container caps and seals to prevent leakage.[3]
4. Ensure each sample is labeled properly according to the servicing laboratory guidance in permanent ink.[4]
5. If applicable, properly cool and wrap each sample according to the servicing laboratory guidance.[5]
6. Pack samples carefully in the shipping container.[6]
7. Pack with sufficient ice.[7]
8. Complete sample request forms legibly in permanent ink.
9. Complete chain of custody forms legibly in permanent ink.
10. Place appropriate documentation inside package and/or fax to laboratory.
11. Seal shipping containers according to servicing laboratory guidance.
12. Label shipping containers according to servicing laboratory guidance and Department of Transportation (DOT) requirements.
13. Ship containers adhering to DOT requirements and proper holding times.[8]
14. Retain a copy of sample request and chain of custody (signed copy) forms.
15. Record the appropriate information in OEHMIS (i.e. DOEHRS)

LOCAL REQUIREMENTS: None

NOTES:

1. The USAFSAM laboratory has a sampling guide, the *USAFSAM Laboratory Sampling Guide* (Air Force) that **MUST** be used when preparing to collect a sample, regardless of the type of sample. USAFSAM has provided a sampling and analysis flowchart in the guide to assist BE personnel with the sampling process. The following guidance is provided for samples being submitted to the USAFSAM laboratory for analysis. Refer to the guide for additional information.

2. Adhere to sample holding times per references above.

3. Attach seal in such a way that it is necessary to break it to open the sample container. When shipping liquid samples, mark the liquid level on the container. This helps to identify samples that have leaked during shipment. Also include absorbent material in the packing to soak up any liquids that may have leaked into the shipping carton.

4. It will be necessary to complete applicable sampling, shipping, and chain of custody forms using your servicing laboratory and shipping carrier's guidance. The forms are generally pretty straight-forward. For example, sampling forms usually document information such as sample identification number (currently generated by DOEHRS), type of sample, name of the person who collected the sample, time/date/location of samples, and type of preservative added (when added).

5. Keep samples as cool as possible to minimize the potential for volatilization or biodegradation between the time of collection and the time of final analysis. Pack samples in cubed or crushed ice or commercial ice substitutes before shipment. Avoid the use of dry ice because it will freeze the samples (in the case of water) or dissolved gases may be lost, and dry ice may break the containers. It could also effect a change in the sample's pH.

6. Always add enough cushioning around and between the samples to prevent breakage. (Do not use styrofoam bits or other static-producing materials for packaging asbestos and other fibrous air samples). Place the original copy of the sampling form in the shipping container just before sealing for shipping. **NOTE**: Never put bulk samples in the same containers with air samples. Check maximum weight and size restrictions for shipping containers set by carrier service.

7. Volume of ice should be at least equal to the volume occupied by samples (twice the volume of ice to samples during warm temperatures).

8. If you are to mail your samples, certified mail is preferred to provide proof of custody. This is also a fast method of shipment; however, some bulk samples such as gasoline, perchloric acid, and organic phosphate compounds cannot be mailed. All samples must be packaged according to the requirements of US Department of Transportation (DOT) or International Air Transportation Association (IATA). Air sampling media are not normally restricted. Consider your base Traffic Management Office (TMO) as a method of shipment. TMO personnel can provide you with guidance on alternate methods as well as advice on shipping hazardous materials. Faster shipment can be made by companies like United Parcel Service (UPS) or Federal Express when necessary. Whether using TMO or a commercial shipper, you need to include a chain-of-custody form to identify each person who has control of your samples. Chain-of –custody allows the ability to trace possession of a sample from the time of collection through analysis and final disposition, and it allows for routine control of samples.

TRAINEE REVIEW QUESTIONS

STS Line Item 4.5.1.3: Prepare and/or preserve samples for shipment

1. What is your initial step for preparing and/or preserving samples for shipment?
2. Samples should be preserved in accordance with what documents?
3. List the information that should be included on a sample label?
4. What sample storage practice minimizes the potential for volatilization or biodegradation between sampling and analysis?
5. Why is wet ice preferred over dry ice for packing and shipping samples?

6. What is the purpose of chain-of custody procedures?

PERFORMANCE CHECKLIST

STS Line Item 4.5.1.3: Prepare and/or preserve samples for shipment

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…	YES	NO
1. Utilize USAFSAM Laboratory Sampling Guide and coordinate sample analysis with servicing laboratory?		
2. Ensure samples are preserved and stored properly according to USAFSAM Laboratory Sampling Guide, the local ESAM Plan, State, or servicing laboratory guidance for each type of sample collected**?**		
3. Tighten and seal all container caps to prevent leakage?		
4. Ensure each sample is labeled properly according to the servicing laboratory guidance in permanent ink?		
5. If applicable, properly cool and wrap each sample according to the servicing laboratory guidance?		
6. Pack samples carefully in the shipping container following servicing laboratory guidance in a manner to prevent bottle breakage, shipping container leakage, and sample degradation?		
7. Pack with sufficient ice?		
8. Complete sample request forms legibly in permanent ink?		
9. Complete chain of custody forms legibly in permanent ink?		
10. Place appropriate documentation inside package and/or fax to laboratory?		
11. Properly seal the shipping container?		
12. Label shipping container according to servicing laboratory guidance?		
13. Ship containers, adhering to DOT requirements and within applicable holding times?		
14. Retain a copy of sample request and chain of custody (signed copy) forms?		
15. Record applicable information in OEHMIS (i.e. DOEHRS)?		
Did the trainee successfully complete the task?		

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. What is your initial step for preparing and/or preserving samples for shipment?

A: Utilize USAFSAM Laboratory Sampling Guide and coordinate sample analysis with servicing laboratory.
(Source: Career Development Course 4B051, and USAFSAM Laboratory Sampling Guide)

2. Samples should be preserved in accordance with what documents?

A: The USAFSAM Laboratory Sampling Guide, local ESAM Plan, State, or servicing laboratory guidance.

(Source: Career Development Course 4B051, and USAFSAM Laboratory Sampling Guide)

3. List the information that should be included on a sample label?

A:

- Sample number (DOEHRS-generated)
- Sample type
- Name of collector
- Sample time/date/location
- Sample preservative

(Source: Career Development Course 4B051, USAFSAM Laboratory Sampling Guide and Standard Methods, Part 1060 B)

4. What sample storage practice minimizes the potential for volatilization or biodegradation between sampling and analysis?

A: Cooling samples (without freezing) as soon as possible after collection

(Source: Career Development Course 4B051, USAFSAM Laboratory Sampling Guide and Standard Methods, Part 1060 C)

5. Why is wet ice preferred over dry ice for packing and shipping samples?

A: Dry ice may freeze samples and may cause glass container to break. Dry ice also may effect a pH change in samples

(Source: Career Development Course 4B051 and Standard Methods, Part 1060 C)

6. What is the purpose of chain-of custody procedures?

A: Chain-of –custody allows the ability to trace possession of a sample from the time of collection through analysis and final disposition.

(Source: Career Development Course 4B051 and Standard Methods, Part 1060 B)

STS Line Item 4.5.1.5.1: Select Appropriate Occupational and Environmental Exposure Limit (OEEL) (TLV, MCL, SPEGL, MEG, STEL, CEILING, Excursion Limits, etc.)

TRAINER GUIDANCE

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.
Prerequisites:	None
Training References:	• NIOSH Pocket Guide
Additional Supporting References:	None
CDC Reference:	4B051
Training Support Material:	• ACGIH TLV Booklet • NIOSH Pocket Guide • OSHA Preambles to the Final Rules: https://www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=PREAMBLES&p_toc_level=0 • NIOSH Criteria Documents: http://www.cdc.gov/niosh/pubs/criteria_date_desc_nopubnumbers.html • Documentation of the Threshold Limit Values for Chemical Substances, 7th Edition: (available through ACGIH store or by contacting USAFSAM) http://www.acgih.org/store/ProductDetail.cfm?id=675
Specific Techniques:	Conduct hands-on training and evaluation of OEEL options to select most appropriate standard.
Criterion Objective:	Given a scenario and references, recommend an appropriate OEEL successfully completing all checklist items with limited trainer assistance on only the hardest parts.
Notes:	

TASK STEPS

1. Identify the possible OEEL options.[1]
2. When OEEL options differ, identify the appropriate basis and/or criteria documents.[2]
3. Review criteria/basis documents.[3]
4. Compare basis/criteria results to each other.[4]
5. Select the most appropriate OEEL.[5]

LOCAL REQUIREMENTS:

NOTES:

1. OEEL options include, but are not limited to, the OSHA PEL, NIOSH REL, and ACGIH TLV. Most often when there are disputing values, it will occur between these three options.
2. Each of the three above organizations have specific methods for documenting the process used to determine their OEELs. The links for each of these are found in the training support materials.

NIOSH RELs are documented in *Criteria Documents* that are developed to provide the basis for comprehensive occupational safety and health standards. These documents generally contain a critical review of the scientific and technical information available on the prevalence of hazards, the existence of safety and health risks, and the adequacy of methods to identify and control hazards. Many chemicals are combined in individual documents under the chemical class. For instance, the criteria information for acetone, methyl ethyl ketone, cyclohexanone, and isophorone (among others) are found in the Ketone criteria document.

OSHA PELs may be documented in the preambles for the final rules. Very few preambles exist for most OSHA PELs. The majority of OSHA PELs are based on the values found in the 1968 ACGIH TLV booklet. Confirmation of this is frequently found in the NIOSH Criteria Document under the section *Basis for Previous Standards*.

ACGIH TLVs are documented in the Documentation of the Threshold Limit Values for Chemicals. This document is available for purchase from ACGIH through the provided website. TLVs are based on available information from industrial experience, from experimental human and animal studies, and when possible, from a combination of all three.

The following information is generally found in each of the various documentation formats (not all information types may be present for each chemical substance): 1) Animal studies which may include acute, subchronic, and chronic effects as well as effects on specific target organs or systems; 2) Human studies which may include case studies, experimental studies, epidemiological studies (e.g. cohort studies), as well as effects on specific target organs or systems.

3. There is a variety of information that should be considered when reviewing the criteria and/or basis documents. The first thing to consider is the date of implementation. Each OEEL has a date it was implemented. For NIOSH RELs, it is the date the criteria document was published. For many OSHA PELs it is the 1968 ACGIH TLV booklet value. To determine when an OSHA PEL value was originally established, a review of the *Historical TLVs* in the TLV basis document is necessary. It will identify the date when a given TLV was first implemented. Pay close attention to TLV dates as many chemicals have both a TWA and a STEL/Ceiling OEEL. A STEL may have been updated recently but the TLV may be decades old.

When reviewing the basis/criteria documents, start by reviewing what type of human studies were used. One type of human

studies is case reports. These provide results of known exposures to the chemical and health results. These may be occupationally related or otherwise. Review these to determine their applicability to an occupational setting. Another type of human study is experimental studies. These involve intentional exposure to known doses under controlled circumstances. These generally are geared toward acute health effects but provide health effect date to specific, known concentrations. A third type of study is epidemiological studies. These usually involve correlating occupational exposures to the chemical to health effects associated with the chemical. They often include the identification of exposure levels as found through air sampling.

In the absence of human information, animal studies would take the next level of precedence. Determine whether the animal studies were done on the chemical of concern or if they were done on other chemicals and extrapoliations or analogies were drawn.

4. When comparing the basis/criteria of one organization's OEEL to another, start by identifying when the OEEL was determined. A more current OEEL generally has more recent studies associated with it. Next, identify the studies that were used in determining the OEELs. This can be done by using the footnotes listed in the documentation and then comparing them to the references. Start with human studies and, as necessary, continue to animal studies. Identify which studies were used in each OEEL. For OSHA PELs, this may not always be possible. For OSHA PELs based on the 1968 ACGIH TLV booklet, identify when the the PEL value TLV was original established by reviewing the Historical TLV or TLV chronology. Once the original date of the value is determined, identify those studies that were done before that date. This should provide a general idea of what information was available at the time the TLV/PEL was established. Once it has been identified which studies were used by multiple organizations, identify those studies that were only used by one organization. This will occur frequently when there is a significant difference in when different agencies established their OEELs. Review the dates of the studies to determine if they were completed during the interim between the OEEL establishment dates, and thus were not available to one organization, or if they were done beforehand and possibly not considered by the agency in the documentation review.

When available, review the exposure data from human studies. Identify any exposure levels with demonstrated health effects below any of the OEELs. For instance, the OSHA PEL for acetone is 1000 ppm and the ACGIH TLV-TWA is 500 ppm. A review of the ACGIH TLV basis document shows workers producing acetone exposed to levels of acetone at 700 ppm showed a variety of health effects. The study showed health effects at a known concentration that was below one of the OEELs, the OSHA PEL. This would suggest the OSHA PEL is not adequately protective against those health effects.

In situations where multiple OEELs were established in close proximity (1-2 years apart) and predominantly used the same studies (80-90%), identify how the OEEL was established. Was the OEEL established based on professional judgment? Was the OEEL established based on a mathematical comparison or conversion? Those with a more scientific method are generally "more appropriate".

This is a simplified hierarchy of precedence when reviewing basis/criteria documents: 1) OSHA, if most stringent, takes precedence over all others; 2) human studies "better than" animal studies; 3) more studies "better than" less studies; 4) more current "better than" older; 5) scientific/mathematical approach "better than" professional judgment.

5. Selection of the "most appropriate" OEEL should take into consideration all the different factors; what types of studies were available, the currency and relevancy of those studies, the number of studies utilized, etc. There is no one right method. The most appropriate value may not always be the most stringent OEEL. The most appropriate value will not always come from the same agency. While ACGIH often has the most current studies, there are cases where NIOSH or OSHA has more current information. A deferment to using the most stringent may result in the application of controls, and thus resources, not required for health protection and possibly creating additional worker hazards. A deferment to using the OSHA PEL may result in exposing workers without protection to exposure levels that may result in health effects. When uncertain, remember to contact the ESOH Service Center for assistance.

TRAINEE REVIEW QUESTIONS

STS Line Item 4.5.1.5.1: Select Appropriate Occupational and Environmental Exposure Limit (OEEL) (TLV, MCL, SPEGL, MEG, STEL, CEILING, Excursion Limits, etc.)

1. Which occupational OEEL is the regulatory OEEL?
2. Which type of studies should take precedence when evaluating basis and/or criteria documents?
3. In the absence of recognized standards, your chain of command should contact who for guidance?
4. Methylene Chloride/Dichloromethane has three distinct OEELs. The OSHA PEL is 25 ppm, the ACGIH TLV Is 50 ppm, and the NIOSH REL is 75 ppm. Which OEEL is most appropriate?
5. When was the OSHA PEL for (N)-Heptane originally established?

PERFORMANCE CHECKLIST

STS Line Item 4.5.1.5.1: Select Appropriate Occupational and Environmental Exposure Limit (OEEL) (TLV, MCL, SPEGL, MEG, STEL, CEILING, Excursion Limits, etc.)

Proficiency Code:	2b
PC Definition:	Can do most parts of the task. Needs help only on hardest parts. Can determine step-by-step procedures for doing the task.

DID THE TRAINEE…		YES	NO
1. Identify the possible OEEL options?			
2. When OEEL options differ, identify the appropriate basis and/or criteria documents?			
3. Review criteria/basis documents?			
4. Compare basis/criteria results to each other?			
5. Select the most appropriate OEEL?			
Did the trainee successfully complete the task?			

TRAINEE NAME (PRINT) TRAINER NAME (PRINT)

ANSWERS

1. Which occupational OEEL is the regulatory OEEL?

   A: OSHA PEL

   (Source: Career Development Course 4B051)

2. Which type of studies should take precedence when evaluating basis and/or criteria documents?

   A: Human studies

   (Source: Note 4 of this QTP)

3. In the absence of recognized standards, your chain of command should contact who for guidance?

   A: USAFSAM/ESOH Service Center.

   (Source: Note 5 of this QTP)

4. Methylene Chloride/Dichloromethane has three distinct OEELs. The OSHA PEL is 25 ppm, the ACGIH TLV Is 50 ppm, and the NIOSH REL is 75 ppm. Which OEEL is most appropriate?

   A: The OSHA PEL (25 ppm)

   (Source: Career Development Course 4B051 and Note 4 of this QTP)

5. When was the OSHA PEL for (N)-Heptane originally established?

   A: OSHA PEL established based on 1968 ACGIH TLV guide. TLV level established in 1946.

(Source: NIOSH Criteria Document: *Alkanes (C5-C8) (ACGIH TLV for 1968) &* ACGIH TLV Basis Document for *Heptane (All Isomers)*)