ARIZONA DEPARTMENT OF HEALTH SERVICES

Guide to Laboratory Services: Chemistry

Bureau of State Laboratory Services
Arizona State Public Health Laboratory
250 North 17th Avenue
Phoenix, Arizona 85007
(602) 542-1188

Bureau of Radiation Control
Radiation Measurements Laboratory
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September 2024

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Table of Contents

General Information

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Hours of Operation:	8:00 am to 5:00 pm Monday through Friday (Emergency services available on nights or weekends when required by public health needs.) Receiving section (Public Health Laboratory) only is open from 9:00 am to 5:00 pm on Saturday.
Annual Holiday Schedule:	Arizona Department of Health Services observes all state-recognized holidays.
Main Location:	250 North 17th Avenue, Phoenix, Arizona 85007
Satellite Location:	4814 South 40th Street, Phoenix, Arizona 85040
Main Telephone Number:	(602) 542-1188 / (800) 525-8915
Main Fax Number:	(602) 364-0281
Satellite Telephone Number:	(602) 255-4845
Emergency Phone (Public Health Laboratory) (Weekends/After Hours):	(602) 887-9283
Emergency Phone (Radiation Control) (Weekends/After Hours):	(480) 202-4982

Arizona State Laboratory Contact Information

Section	Supervisor	Telephone Number
Receiving /Shipping	Adrian Fichter adrian.fichter@azdhs.gov	(602) 542-1190
Food Emergency Response Network / Public Health Chemistry	Amber Riendeau amber.riendeau@azdhs.gov	(480) 521-2758
Chemical Emergency Response	Sarah Brown sarah.brown@azdhs.gov	(480) 904-4040
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Radiation Measurements Laboratory email: RML@azdhs.gov

Radioactive Materials Licensing email: RAM@azdhs.gov

Radon email: RADON@azdhs.gov

Core Functions and Capabilities of State Public Health Laboratories – Chemistry

ADHS Chemistry provides direct and reference laboratory services to county, state, tribal, and federal governmental agencies to aid in the determination of the presence and concentration of chemical analytes of public health concern. The program has the capability to analyze both organic and inorganic compounds in a wide variety of matrices, including, but not limited to, environmental, food, and clinical samples.

The Chemical Emergency Response (CT) section is capable of testing clinical samples for a select number of chemical agents and/or the metabolites of chemical agents, identified by the Centers for Disease Control and Prevention (CDC) Laboratory Response Network – Chemical (LRN-C) as those likely to be used during an act of terrorism or that may present a public health risk in the event of an accidental release. The purpose of the CT program is to determine the extent of exposure to the jurisdictional population (i.e., all of Arizona) during an event involving an accidental or intentional release of a poisonous chemical compound. The CT program works closely with ADHS epidemiologists and PHEP program staff.

The Public Health Chemistry (PHC) program performs environmental work utilizing a mixture of Environmental Protection Agency (EPA) and in-house analytical methods to perform analyses in water, soil, and other matrices of public health concern. This includes the characterization of environmental unknowns arising from emergency response situations involving incidents of public health concern and environmental samples arising from non-emergency situations originating in the 15 Arizona counties.

As part of the Food Emergency Response Network (FERN), the program is involved in food defense and food safety activities involving the analysis of both organic and inorganic analytes. Activities include method development on GC/MS, LC/MS/MS, and ICP/MS platforms, the introduction of new toxins/poisons into existing FERN analytical methods, assisting in laboratory validations of new analytical methods, and working with our Federal partners during activations of the Food Emergency Response Network.

The Toxicology program assists with improving the understanding of what opioids are responsible for causing overdoses in Arizona by testing for opioids and opioid metabolites as well as cannabinoids. This program works with medical examiners and epidemiologists throughout the state.

The Radiation Measurements Laboratory (RML) is one of four radiological health programs within the Bureau of Radiation Control (BRC). The RML has the responsibility for the off-site environmental radiological monitoring of air, water, soil, and biota samples for fixed nuclear facilities, uranium milling and tailings sites, and uranium leaching operations. In conjunction with this responsibility, an environmental monitoring network and laboratory facility have been developed to evaluate existing and future levels of radioactivity in air, water, milk, biota, and other appropriate ingestion pathways. The analysis of this data provides the state with necessary baseline radioactivity measurements that ultimately lead to the protection of public health from radiological hazards.

Sample Rejection Policy

Chemical Emergency Response

The Chemical Emergency Response section may refuse samples and request resampling if the following qualifications are not met:

1. Method-specific sample volume requirements are shown in the Quick Reference Chart and are further detailed in the method narrative guidelines. Submitters should make every effort to collect and submit the appropriate volume of sample for analysis. However, all attempts will be made to test the samples if less than the ideal sample amount is submitted.
2. Urine and blood cannot be shipped together.
3. Urine samples must be sent to the lab on dry ice. Ideally, the urine samples should be frozen prior to submission to the laboratory.
4. Blood must be cold (between 1 °C – 10 °C) but not frozen.
5. Samples suspected of contamination shall be rejected.
6. Broken or leaking sample containers shall be rejected.
7. Samples bearing improper identification labels or missing identification labels shall be rejected. Specimen labels must contain, at a minimum, the patient's first and last name or patient ID number.
8. Sample collection tubes and containers that are expired shall be rejected.
9. Samples submitted in the improper sample container, including incorrect blood tube type, shall be rejected.
10. Blood specimens that are clotted shall be rejected.

Exceptions to this policy will be considered due to extenuating circumstances; however, final approval to make an exception can only be made by the Laboratory Director, Bureau Chief, Assistant Bureau Chief, or Technical Supervisor.

Public Health Chemistry

The Public Health Chemistry section may refuse samples and request resampling if the following qualifications are not met:

1. Water sample is not received within 14 days of sampling.
2. Samples with insufficient quantity.

Food Emergency Response Network

The Food Emergency Response Network section may refuse samples and request resampling if the following qualifications are not met:

1. Samples with insufficient quantity.

Toxicology

The Arizona State Public Health Laboratory (ASPHL) may refuse to accept clinical/reference specimens for testing if the following circumstances exist:

1. Method-specific sample volume requirements not met. Submitters should make every effort to collect and submit the appropriate volume of sample for analysis. However, all attempts will be made to test the samples if less than the ideal sample amount is submitted.
2. The identifier on the specimen did not match the identifier on the submission form, or there was no identification on the specimen. Specimen labels must contain, at a minimum, the patient's first and last name or unique patient ID number.
3. Clinical/epidemiological information submitted with the specimen was either insufficient or incomplete.
4. The specimen was too long in transit between the time of collection and time of receipt.
5. Blood should be cold (between 1 °C – 10 °C) but not frozen, and will be accepted so long as it is between 1 °C – 25 °C.
6. Blood specimens were hemolyzed or contaminated.
7. The specimen was broken or leaked in transit.
8. Specimen was submitted in an improper or expired container, including incorrect blood tube type.

Exceptions to this policy will be considered due to extenuating circumstances; however, final approval to make an exception can only be made by the Laboratory Director, Bureau Chief, or Assistant Bureau Chief.

The Shipping and Receiving section staff receive samples/specimens for the above programs but do not determine acceptance or rejection status. Acceptance or rejection of samples/specimens is determined by the testing sections.

Radiation Measurements Laboratory

Samples are considered contaminated if the count rate of a smear or swipe, taken from the outside of the package or sample container, for loose contamination has a count rate of greater than 2 times above background with a pancake GM probe.

All samples receive a contact dose reading before entering the laboratory. If the count rate is 250 μR/hr above background, it will be stored in the calibration range. The dose rate will be recorded on the respective sample form. Any sample having an emission rate of 0.5 mrem/hr must be stored in a secured location away from drinking water samples. Method specific sample volume requirements are listed in the sample collection section. Submitters should make every effort to collect and submit the appropriate volume for sample analysis. Broken or leaking samples may be refused at the discretion of the RML supervisor or the Radiation Safety Officer (RSO).

Section 1: Chemical Emergency Response

The Chemical Emergency Response (CT) section is capable of testing clinical samples for a select number of chemical agents identified by the Centers for Disease Control and Prevention (CDC) Laboratory Response Network – Chemical (LRN-C) as compounds most likely to be used during an act of terrorism or to present a public health risk in the event of an accidental exposure. Clinical specimens of patients exposed to an intentional or accidental release of the compounds listed below should be collected and sent to the State Public Health Laboratory for testing as soon as possible to ensure the reliability of test results. The specimen type (blood, serum, or urine) is specific to the type of testing to be performed. Detailed information regarding sample collection procedures for any of the following tests can be obtained in the narrative guidelines that follow.

Please contact and alert the Chemical Emergency Response Laboratory at (480) 904-4040 or (602) 739-6105 before submitting samples for chemical analysis. In the event that an intentional release of any chemical agent is suspected, contact the Arizona Counter Terrorism Information Center (ACTIC) at (602) 644-5805 to inform them of the incident.

The CT section works in conjunction with the Food Emergency Response Network (FERN) section in the analysis and identification of suspicious powder or unknown samples. For additional details regarding the collection and submission of suspicious substances/unknowns, refer to GC-MS Pharmaceuticals Screen section below.

Quick Reference Guide

Agent / Chemical	Specimen Type and Quantity*	Transport Container and Conditions	Instrument / Detection	Comments†
Abrine and Ricinine (Biomarkers for Abrin and Ricin toxins)	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-20 °C.	LC-MS/MS	Sample is preferably collected within 48 hours of exposure.
CVAA (Lewisite metabolite)	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-70 °C.	LC-ICP-MS or LC-ICP-QQQ	Sample is preferably collected within 48 hours of exposure.
Creatinine	Urine Ideal sample size: 40-60 mL Minimum required: 50 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-20 °C.	LC-MS/MS	Sample is preferably collected within 48 hours of exposure
Cyanide	Blood Ideal sample size: 2+ blood tubes Minimum required: 4 mL	Vacuum-fill, non-gel, purple-top (EDTA) tubes (4-mL or larger). Store at 5 ± 3 °C. DO NOT FREEZE.	GC-MS	Collect sample as soon as possible after exposure.
HNPAA (Tetranitromethane metabolite)	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-20 °C	LC-MS/MS	Sample is preferably collected within 48 hours of exposure.
Metals in Blood (Hg, Pb, Cd)	Blood Ideal sample size: 2+ blood tubes Minimum required: 4 mL	Vacuum-fill, non-gel, purple-top (EDTA) tubes (4-mL or larger). Store at 5 ± 3 °C. DO NOT FREEZE.	ICP-MS or ICP-QQQ	Sample is preferably collected within 48 hours of exposure. **Number blood tubes in order of fill.**
Metals in Urine (As, Ba, Be, Cd, Hg, Pb, Tl, U)	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-20 °C.	ICP-MS or ICP-QQQ	Sample is preferably collected within 48 hours of exposure.

Agent / Chemical	Specimen Type and Quantity*	Transport Container and Conditions	Instrument / Detection	Comments†
Nerve Agents (Metabolites of sarin, soman, VX, cyclohexylsarin, and Russian VX)	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-70 °C	LC-MS/MS	Sample is preferably collected within 48 hours of exposure.
	Serum Ideal sample size: 2+ blood tubes Minimum required: 4 mL	Vacuum-fill, non-gel, gray- or green-top (heparin) tubes (4-mL or larger). Store at 5 ± 3 °C. DO NOT FREEZE.	LC-MS/MS	Sample is preferably collected within 48 hours of exposure
Tetramine	Urine Ideal sample size: 40-60 mL Minimum required: 5 mL	Urine collection cups. Stored in freezer or on dry ice at ≤-20 °C.	GC-MS	Sample is preferably collected within 48 hours of exposure.
Volatile Organic Compounds (VOCs)‡	Blood Ideal sample size: 2+ blood tubes Minimum required: 4 mL	Vacuum-fill, non-gel, gray- or green-top (heparin) tubes (4-mL or larger). Store at 5 ± 3 °C. DO NOT FREEZE.	GC-MS	Collect sample as soon as possible after exposure.
GC-MS Pharmaceuticals Screen	Pill or Powder Minimum required: 0.5 g pill or powder	Original packaging sealed in a plastic bag Store refrigerated or frozen if perishable	GC-MS	

* If less than the ideal sample volume cannot be obtained, sample analysis will be performed on a case-by-case basis.

† Submitters will be notified of positive results as soon as results are confirmed. Final reports will be issued within the standard turn-around time (TAT) of 30 days.

‡ See method narrative for a complete list of VOCs offered.

Abrine and Ricinine

Ricin and abrin are toxic proteins derived from the *Ricinus communis and Abrus Precatorius* plants, respectively. Ricinine and abrine are biomarkers used to test for ricin and/or abrin exposure.

Collection

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

A detectable ricinine or abrine biomarker in urine should be assumed to imply exposure to ricin or abrin, respectively. The submitting agency will be notified of positive results via telephone, fax or e-mail once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Creatinine

Creatinine is a waste by-product of normal muscle function in human blood and is filtered through the kidneys to be excreted into urine. Because creatinine is excreted at a relatively constant rate it is used in the clinical field as a biomarker to denote the hydration of the individual presenting a urine sample. This allows medical professionals and epidemiologists to normalize the laboratory results of an individual to account for that particular person's hydration level at the time of void – a process called creatinine correction.

Collection

Since the analyte of interest is a human byproduct of muscle activity, no special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. The ideal sample submission would be 40-60 mL. A minimum of 50 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

The normal range for random urine collection is 370 to 3000 mg/L. Literature values reported in the State of Washington "Creatinine in Urine" stated that normal ranges for creatinine ranged from 400 to 3000 mg/L for men and 370 to 2500 mg/L for females. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

CVAA (2-Chlorovinylarsonous acid)

Lewisite, a chemical warfare agent with no other known uses, is an oily, colorless liquid in its pure form. It can appear amber to black in its impure form with an odor resembling geraniums. It is a highly toxic vesicant, causing blistering of the skin and mucous membranes within minutes of contact. CVAA (2-chlorovinylarsonous acid) is the primary metabolite of Lewisite.

Collection

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice, prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

A detectable level of CVAA in urine should be assumed to imply an exposure to Lewisite. The submitting agency will be notified of positive results via telephone, fax or e-mail once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Cyanide

Cyanide (CN) is a potent and rapidly acting toxic agent which prevents tissues from utilizing oxygen (hypoxia).

Collection

No special instructions such as fasting or special diets are required. A small amount of cyanide is present in all blood samples. Because cyanide is present at higher amounts in the blood of cigarette smokers (9.62 – 20.8 ppb), the smoking status of the individual providing the sample should be collected upon draw but is not required. Whole blood specimens should be collected from subjects as quickly as possible after exposure since blood cyanide is converted in the body to thiocyanate or lost through respiration.

Specimens are collected in 4-mL or larger vacuum-fill (vacutainer) blood tubes containing EDTA as the anticoagulant agent. Heparin may also be used. Headspace in the vacutainers should be minimized if possible. However, because cyanide in blood has only minimal volatility at biological pHs, if only a small amount of sample is available, the headspace in the vacutainer will not seriously impact the accuracy of the analysis. Invert the blood tubes 2-3 times after collection in order to distribute the anticoagulant throughout the blood.

The ideal sample submission would be two or more blood tubes (4-mL or larger). However, for samples submitted during an **emergency chemical exposure event situation**, three (4-mL or larger) purple-top (EDTA) blood tubes are requested. A minimum of 4 mL should be submitted in any case. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Samples should be properly labeled and refrigerated at 5 ± 3 °C as soon as possible.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

A level of <100 µg/L is generally accepted as normal. Levels greater than 1000 µg/L are considered toxic and even potentially lethal. Cyanide toxicity is very rapid so the victim will die quickly from a lethal dose. Once the victim is removed from a non-lethal source of exposure, the cyanide will be rapidly cleared from the victim's body. Since the results from this analysis will not be available for several hours, immediate treatment based on these results will not be meaningful. Therefore, no call value is specified with this procedure.

The submitting agency will be notified of elevated results via telephone, fax or e-mail once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

HNPAA (4-Hydroxy 3-Nitrophenylacetic Acid)

Tetranitromethane is a compound that is present in explosives, especially TNT, as well as some diesel fuels. 4-Hydroxy 3-nitrophenylacetic acid (HNPAA) is a metabolite of tetranitromethane.

Collection

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice, prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

A detectable level of HNPAA in urine should be assumed to imply an exposure to tetranitromethane. The submitting agency will be notified of positive results via telephone, fax or e-mail once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Metals in Blood

Mercury (Hg), lead (Pb), and cadmium (Cd) are considered to be toxic at certain levels.

Collection

No special instructions such as fasting or special diets are required. Use sterile collectors for specimen acquisition. Specimens are collected in 4-mL or larger non-gel vacuum-fill (vacutainer) blood tubes containing EDTA as the anticoagulant agent (purple-top). Only those specimens preserved with EDTA will be accepted, all other anticoagulants will be rejected. Invert the blood tubes 2-3 times after collection in order to distribute the anticoagulant throughout the blood. Indicate on each tube the order in which they were drawn (#1, #2, etc.). Samples should be properly labeled and refrigerated at 5 ± 3 °C as soon as possible.

The ideal sample submission would be two or more blood tubes (4-mL or larger). However, for samples submitted during an **emergency chemical exposure event situation**, three (4-mL or larger) purple-top (EDTA) blood tubes are requested. A minimum of 4 mL should be submitted in any case. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

For mercury (Hg) in blood, the critical call level for all ages is >50 µg/L.

For cadmium (Cd) in blood, the critical call level for all ages is >5 µg/L.

For lead (Pb) in blood, the critical call level for children 6 years of age and younger is >3.5 µg/dL and for adults is >40 µg/dL. Refer to the CDC website for most current limits (https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm).

Refer to National Health and Nutrition Examination Survey (NHANES) website at https://cdc.gov/NHANES for the most recent national average blood metals values.

The submitting agency will be notified of elevated results via telephone, fax or e-mail, once results are confirmed. Any results at or above the critical call values will be reported to the supervising physician as soon as possible. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Metals in Urine

This method is used to achieve rapid and accurate quantification of multiple elements of toxicological interest: arsenic (As), beryllium (Be), cadmium (Cd), barium (Ba), mercury (Hg), thallium (TI), lead (Pb), and uranium (U).

Collection

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. Freeze samples immediately and store on dry ice for shipping. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice, prior to submission to the laboratory, or stored on dry ice prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

There is no routine notification for elevated levels for the metals determined with this method. Highly elevated levels will be reported to the supervising physician or submitting agency via telephone, fax, or e-mail, once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Refer to National Health and Nutrition Examination Survey (NHANES) website at https://cdc.gov/NHANES for the most recent national average urine metals values.

Nerve Agents

The organophosphorus nerve agents sarin (GB), soman (GD), cyclohexylsarin (GF), Russian VX (rVX) and VX, are extremely poisonous substances used most often in chemical warfare and terrorism activities. Exposure to these nerve agents is identified by testing for the presence of the metabolites of these nerve agents in potentially exposed individuals.

Collection

Urine:

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice, prior to submission to the laboratory, or stored on dry ice prior to submission to the laboratory.

Serum:

No special instructions such as fasting or special diets are required. Blood specimens should be collected from subjects as quickly as possible after exposure. Specimens are collected in 4-mL or larger vacuum-fill (vacutainer), non-gel, gray- or green-top (heparin) blood tubes. Invert the blood tubes 2-3 times after collection in order to distribute the anticoagulant throughout the blood.

The ideal sample submission would be two or more blood tubes (4-mL or larger). A minimum of 4 mL should be submitted in any case. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Samples should be properly labeled and refrigerated at 5 ± 3 °C as soon as possible.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

Any detectable level of a nerve agent metabolite in urine or serum should be assumed to imply exposure to the nerve agent corresponding to the detected metabolite. The submitting agency will be notified of positive results via telephone, fax or e-mail, once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Tetramine

Tetramethylene disulfotetramine (tetramine or TETS) is a potent neurotoxin that is most often used as a rodenticide. It has been banned worldwide, but can still be easily found in China. It has been implicated in several cases of mass poisoning.

Collection

No special instructions such as fasting or special diets are required. Collect urine specimens from subjects in standard urine collection cups. Use sterile collectors for specimen acquisition. In the case of a suspected exposure, collect 40-60 mL or more of urine as soon as possible after the incident, preferably within 48 hours. The ideal sample submission would be 40-60 mL. A minimum of 5 mL is required to perform the analysis. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Urine samples should be frozen, or stored on dry ice, prior to submission to the laboratory, or stored on dry ice prior to submission to the laboratory.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

Any detectable level of tetramine in urine should be assumed to imply exposure. The submitting agency will be notified of positive results via telephone, fax or e-mail, once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

Volatile Organic Compounds

Volatile Organic Compounds (VOCs) are a broad category of chemicals which include many toxic industrial compounds. The current VOC panel contains the following: chloroform, 1,2 dichloroethane, benzene, carbon tetrachloride, toluene, tetrachloroethylene, ethylbenzene, m- & p-xylene, styrene, and o-xylene.

Collection

No special instructions such as fasting or special diets are required. Whole blood specimens should be collected from subjects as quickly as possible after exposure. Specimens are collected in 4-mL or larger vacuum-fill (vacutainer), non-gel, gray- or green-top (heparin) blood tubes. Invert the blood tubes 2-3 times after collection in order to distribute the anticoagulant throughout the blood.

The ideal sample submission would be two or more blood tubes (4-mL or larger). A minimum of 4 mL should be submitted in any case. If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis. Samples should be properly labeled and refrigerated at 5 ± 3 °C as soon as possible.

Shipment of Specimens

Refer to *Section 6: Sample Submission Guidelines – Chemical Emergency Response* for proper specimen shipping instructions.

Reporting and Interpretation of Results

The health effects resulting from exposure to low levels of volatile organic compounds are currently unclear. Finding a measurable amount of VOCs in blood does not mean that the level causes an adverse health effect. Therefore, no critical call values are available.

Refer to National Health and Nutrition Examination Survey (NHANES) website at https://cdc.gov/NHANES for the most recent national average levels of volatile organic chemicals in blood.

The submitting agency will be notified of elevated results via telephone, fax or e-mail, once results are confirmed. A final report containing all specimen results will be issued within the standard turn-around time (TAT) of 30 days.

GC-MS Pharmaceuticals Screen

This analysis is intended to offer a qualitative examination of pills, powders, or liquids for the presence of potentially toxic materials such as drugs, poisons, or other contaminants which are amenable to analysis by gas chromatography.

Collection

At least 0.5 g of pill or powder sample and at least 2 mL of liquid are needed for analysis. If possible, submit the product label which includes the **brand name** and the **lot number**.

Shipment of Specimens

Refer to *Section 8: Sample Submission Guidelines – Food Emergency Response Network* for proper specimen shipping instructions for these samples.

Reporting and Interpretation of Results

The results of this test are purely qualitative. The assay may confirm the presence of an adulterant but not the amount of adulterant present in the sample. The submitting agency will be notified of positive results via email or phone once results are confirmed. A final report containing all sample results will be sent by mail or email copy.

Section 2: Public Health Chemistry

The Public Health Chemistry (PHC) section is capable of testing non-clinical samples for a selection of chemical agents identified by the Environmental Protection Agency (EPA), Arizona Department of Environmental Quality (AZDEQ), and the American Public Health Association (APHA). These are compounds that are likely to be present as a public health risk in the event of a contamination incident. Detailed information regarding sample collection procedures for any of the following tests can be obtained in the narrative guidelines that follow.

Please contact the Public Health Chemistry laboratory at (480) 521-2758 prior to submitting samples for chemical analysis.

Quick Reference Guide

Sample Collection and Holding Time Requirements – Safe Drinking Water Analysis

SAFE DRINKING WATER ANALYSIS:						
PARAMETER	**ANALYTICAL METHOD[A]**	**METHOD REPORTING LEVEL[B]**	**SPL CONT[C]**	**MIN SPL SIZE[D]**	**PRESERVATION[E]**	**MAXIMUM HOLDING TIME[F]**
REGULATED PRIMARY METALS						
Antimony	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Arsenic	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Barium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Beryllium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Cadmium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Chromium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Mercury	EPA 200.8 (5.4)	0.1 µg/L	P	0.5 L	HNO_3 pH < 2	28 days
Selenium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Thallium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Uranium	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
SPECIAL MONITORING REQUIREMENTS						
Lead	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Copper	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Nickel	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months

SAFE DRINKING WATER ANALYSIS:						
PARAMETER	**ANALYTICAL METHOD[A]**	**METHOD REPORTING LEVEL[B]**	**SPL CONT[C]**	**MIN SPL SIZE[D]**	**PRESERVATION[E]**	**MAXIMUM HOLDING TIME[F]**
Molybdenum	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
SECONDARY CONTAMINANTS: METALS						
Manganese	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months
Zinc	EPA 200.8 (5.4)	0.5 µg/L	P	0.5 L	HNO_3 pH < 2	6 months

Sample Collection and Holding Time Requirements – Footnotes

A. Analytical Method

References: EPA is the United States Environmental Protection Agency. EPA methods are found in:

- Methods for the Chemical Analysis of Water and Wastes (MCAWW), EPA-600/4-79-020, March 1983;
- Methods for the Determination of Metals in Environmental Samples – Supplement I, EPA-600/R-94-111, May 1994;
- Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93-100, August 1993;
- Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised July 1991, Supplement I, 1990, Supplement II, 1992 and Supplement III, 1995;
- 40 Code of Federal Regulations, Part 136, Appendix A;
- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition including Updates I, II A&B and III;
- SM refers to methods referenced in Standard Methods for the Examination of Water and Wastewater, 19th Edition, 1995, or 20th Edition, 1998, APHA, AWWA, & WEF.

B. Method Reporting Level

This is the Arizona State Public Health Laboratory determined value, which represents the optimum value obtainable from a sample with no matrix interferences. It is the amount of an analyte above the method detection limit level (MDL) that can be reported with sufficient precision and accuracy.

C. Sample Container (SPL CONT)

- P = polyethylene or equivalent

D. Minimum Sample Size Recommended (MIN SPL SIZE)

Represents the minimum recommended amount of sample to be collected in either milliliters

(mL) or grams (g) necessary to perform an individual test. However, if several tests are to be performed on the sample, the minimum sample amount necessary is not additive. Contact the Lab for further information.

- DUP = collect duplicate containers.

E. Preservation

The information listed is transcribed from 40 CFR Parts 136 & 141.

- HNO_3 = nitric acid

F. Maximum Holding Time

The times listed are transcribed from 40 CFR Parts 136 & 141.

Analysis of Water Samples for Metals

Collection

Refer to the Quick Reference Charts for information regarding sample collection container, sample size, and preservation.

Shipment of Specimens

Samples are transported to the laboratory after sampling. If shipped, samples are shipped using approved ADOT guidelines. Refer to *Section 7: Sample Submission Guidelines – Public Health Chemistry* for additional information.

Reporting and Interpretation of Results

Refer to the Quick Reference Charts for method reporting levels by analyte. The submitting agency may be notified of results via telephone, fax or e-mail once results are confirmed. A final report containing all sample results will be sent by mail.

Analysis of Other Samples for Lead

The Food Emergency Response Network and Public Health Chemistry programs analyze lead (Pb) environmental samples for the ADHS Childhood Lead Poisoning Prevention Program (CLPPP) and/or Arizona county and tribal agencies involved in the point source investigation of lead-poisoned children.

Collection

Specimens are collected by Office of Environmental Epidemiology (OEE) staff. These samples may include makeup, ointments/liquids, spices, and/or other food products. Refer to the Food Emergency Response Network (FERN) section for food items. Chemistry does not currently test for soils, paint chips, and/or dust wipes.

Shipment of Specimens

Samples are transported to the laboratory after sampling. If shipped, samples are shipped using approved ADOT guidelines. Refer to *Section 7: Sample Submission Guidelines – Public Health Chemistry* for additional information.

Reporting and Interpretation of Results

The submitting agency may be notified of results via telephone, fax or e-mail once results are confirmed. A final report containing all sample results will be sent by mail.

Section 3: Food Emergency Response Network (FERN)

The Food Emergency Response Network (FERN) section is capable of testing food and beverage samples for chemical adulterations using methods developed by the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) Food Safety Inspection Service (FSIS). The adulterants tested for may include but are not limited to pesticides, cleaning products, narcotics, heavy metals, and poisons. Detailed information regarding sample collection procedures for any of the following tests can be obtained in the narrative guidelines that follow.

Please contact the Food Emergency Response Network section laboratory at (480) 521-2758 prior to submitting samples.

Quick Reference Guide

Agent / Chemical	Specimen Type and Quantity*	Instrument / Detection
CHE.0008 Poison/Toxin Screen	Food Minimum required sample size: 1 g or 1 mL	LC-HRMS
CHE.0006 Toxin Screen	Food Minimum required sample size: 8 g or 8 mL	GC-MS
EAM 4.7	Food Minimum required sample size: 2 g or 20 mL	ICP-MS

CHE.0008 Poison/Toxin Screen

This analysis is intended to offer a qualitative examination of a variety of food matrices for the presence of potentially toxic materials such as drugs, pesticides, or other contaminants which are amenable to analysis by high pressure liquid chromatography mass spectrometry.

Collection

At least 1.0 g or 1 mL of food or beverage is needed for analysis. Ideally, perishable samples should be refrigerated or frozen prior to submission. If possible, submit the product label which includes the **brand name** and the **lot number**.

Shipment of Specimens

Refer to *Section 8: Sample Submission Guidelines – FERN* for proper specimen shipping instructions.

Reporting and Interpretation of Results

The results of this test are purely qualitative. The assay may confirm the presence of an adulterant but not the amount of adulterant present in the sample. The submitting agency will be notified of positive results via email or phone once results are confirmed. A final report containing all sample results will be sent by mail or email copy.

CHE.0006 Toxin Screen

This analysis is intended to offer a qualitative examination of a variety of food matrices for the presence of potentially toxic materials such as drugs, pesticides, or other contaminants which are amenable to analysis by gas chromatography mass spectrometry.

Collection

At least 8 g or 8 mL of sample is required for analysis. Ideally, perishable samples should be refrigerated or frozen prior to submission. If possible, submit the product label which includes the **brand name** and the **lot number**.

Shipment of Specimens

Refer to *Section 8: Sample Submission Guidelines – FERN* for proper specimen shipping instructions.

Reporting and Interpretation of Results

The results of this test are purely qualitative. The assay may confirm the presence of an adulterant but not the amount of adulterant present in the sample. The submitting agency will be notified of positive results via email or phone once results are confirmed. A final report containing all sample results will be sent by mail or email copy.

EAM 4.7

EAM 4.7 – ICP-MS Determination of Select Inorganic Elements in Food Using Microwave-Assisted Digestions, is the Food and Drug Administration's method for quantitative determination of select metal elements using ICP-MS in liquid, semi-solid, or solid foods. The following elements are monitored in the analysis: arsenic, cadmium, chromium, copper, lead, manganese, molybdenum, mercury, nickel, selenium, thallium, and zinc.

Collection

At least 2 g of food and/or 20 mL of liquid is required for analysis. If possible, submit the product label which includes the **brand name** and the **lot number**.

Shipment of Specimens

Refer to *Section 8: Sample Submission Guidelines – FERN* for proper specimen shipping instructions.

Reporting and Interpretation of Results

The submitting agency will be notified of positive results via email or phone once results are confirmed. A final report containing all sample results will be sent by mail or email copy.

Section 4: Toxicology

In order to improve understanding of what opioids are responsible for causing overdoses in Arizona and to better target treatment and prevention efforts, the Arizona State Public Health Laboratory introduced laboratory testing for stimulants, benzodiazepines, opioids and opioid metabolites.

Postmortem toxicology results are returned to the medical examiners who submitted the samples.

For questions regarding submitting samples to the laboratory, please contact Receiving, or visit https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php.

Refer to *Section 9: Sample Submission Guidelines – Toxicology* for additional information.

Quick Reference Guide

Agent / Chemical	Specimen Type and Quantity	Transport Container and Conditions	Instrument / Detection	Comments
Toxicology Forensic Screen	Blood Ideal sample size: 1 blood tube Minimum required: 3 mL	Vacuum-fill, non-gel, **purple-top** (EDTA) tube (3-mL or larger). Store at 5 ± 3 °C. Post-mortem specimens may be frozen.	LC-HRMS	Vacuum-fill, non-gel, **gray-top** (potassium oxalate/ NaF) tube (3-mL or larger) may also be used, but **purple-top** tubes are preferred.
Toxicology Forensic Panel	Blood Ideal sample size: 1 blood tube Minimum required: 3 mL	Vacuum-fill, non-gel, **purple-top** (EDTA) tube (3-mL or larger). Store at 5 ± 3 °C. Post-mortem specimens may be frozen.	LC-HRMS	Vacuum-fill, non-gel, **gray-top** (potassium oxalate/ NaF) tube (3-mL or larger) may also be used, but **purple-top** tubes are preferred.
Fentanyl Analogues	Blood Ideal sample size: 1 blood tube Minimum required: 3 mL	Vacuum-fill, non-gel, **purple-top** (EDTA) tube (3-mL or larger). Store at 5 ± 3 °C. Post-mortem specimens may be frozen.	LC-HRMS	Vacuum-fill, non-gel, **gray-top** (potassium oxalate/ NaF) tube (3-mL or larger) may also be used, but **purple-top** tubes are preferred.
THC Metabolites	Blood Ideal sample size: 1 blood tube Minimum required: 3 mL	Vacuum-fill, non-gel, **purple-top** (EDTA) tube (3-mL or larger). Store at 5 ± 3 °C. Post-mortem specimens may be frozen.	GC-QQQ	Vacuum-fill, non-gel, **gray-top** (potassium oxalate/ NaF) tube (3-mL or larger) may also be used, but **purple-top** tubes are preferred.

A list of analytes on the panel can be located here:
https://www.azdhs.gov/documents/preparedness/state-laboratory/chemistry/toxicology-analyte-list.pdf.

Section 5: Radiation Measurements Laboratory

The sampling programs of the RML provide valued support to the Bureau of Radiation Control (BRC) by providing essential baseline data to concerned state officials, agencies, and the general public during an actual emergency.

Specific Environmental Surveillance Programs include the following:

A. Palo Verde Generating Station (PVGS)

The PVGS Environmental Sampling Program is concerned with the evaluation of changes in baseline levels of radiation in the environs of PVGS due to plant operation. The assessment includes air, water, soil, and vegetation samples.

B. Statewide

The Statewide Environmental Sampling Program was initiated with the express purpose of supplementing the baseline data obtained and documented in the PVGS programs and major regions of Arizona. Baseline background radiation levels are collected by strategic placement of TLDs (thermoluminescent dosimeters) in various locations throughout the state.

C. Radioactive Materials Compliance Program

The RML, in support of the Radioactive Materials Compliance Program, analyzes samples collected by regulatory officers during routine licensee compliance inspections, incident investigations, or radiological emergencies. Samples are analyzed to determine the amount and extent of radiation contamination and/or exposure to radiation workers and the general population.

D. Food Emergency Response Network (FERN)

The RML collects and analyzes select foodstuffs for gamma emitting radionuclides, as well as screening for and quantifying gross alpha and gross beta activity. The lab participates in all FERN activities, exercises, and proficiency tests.

Quick Reference Guide

Analyte / Parameter	Matrix	Ideal Sample Size	Preservation	Nuclear Instrumentation
Carbon 14	Soil/Solid/Sludge	400 g	none	Liquid Scintillation Counter
	Swipe	1 swipe / smear	none	
	Water	500 mL	none	
Gamma Emitters	Air	1 cartridge / filter	none	Gamma Spectroscopy
	Milk	4 L	none	
	Soil/Solid/Sludge	400 g	none	
	Swipe	1 swipe / smear	none	
	Water	4 L	none	
	Vegetation	1 gallon	none	
Gross Alpha	Soil/Solid/Sludge	400 g	none	Gas Flow Proportional Counter
	Swipe	1 each	none	
	Vegetation	1 gallon	none	
	Water	2 L	HNO_3	
Gross Beta	Air	1 filter	none	Gas Flow Proportional Counter
	Soil/Solid/Sludge	400 g	none	
	Swipe	1 swipe / smear	none	
	Vegetation	1 gallon	none	
	Water	2 L	HNO_3	
Tritium	Soil/Solid/Sludge	400 g	none	Liquid Scintillation Counter
	Swipe	1 swipe / smear	none	
	Vegetation	1 gallon	none	
	Water	500 mL	none	

Sample Collection

Sample collection processes vary by matrix.

Milk

Dairy farmers typically milk their cows 2-3 times a day. The raw milk is placed into temperature-controlled milk tanks until a milk truck arrives to fill their tank and transport the milk to a dairy processing center. A raw milk sample is collected at the individual dairy by connecting Tygon tubing to a sterile hypodermic needle and pushing it into the sample port or by pressing on a flow nozzle. This will create a flow of raw milk into a 4 L cubitainer. Four to eight liters of sample volume is recommended for this matrix.

Water

Samples are collected in plastic 4 L cubitainers. Water samples are preserved within 5 days of sample collection by adding 16N HNO_3 to a pH of <2. Prior to acidification, an aliquot may be taken for gamma spectroscopy analysis. NOTE: Samples requiring analysis for ^{3}H and ^{14}C are not acidified and are collected in 500 mL French square bottles. If applicable, add a small amount of sample water to the container and rinse the container; repeat this process 3 times (see RAD-007 Sample Management for more details). Fill the sample container to within 2 cm (0.75 inch) of the cap and close the container.

Air

A charcoal cartridge is installed downstream from the particulate filter and connected to the suction end of the pump with a flow-rate indicator. Secure the air sampler to a tripod, table, platform, vehicle hood or tailgate, or other sturdy non-moving surface. Position the sampling unit with the air intake facing the source of the suspected contamination, making sure the face of the sampler is in the breathing zone, approximately 1.25 to 2 m (4 to 6 feet) above the ground surface. Position the sampling unit to avoid interferences from structures, by placing the unit at a distance twice as far as the height of the tallest immediate building.

Soil, Solid, Sediment, Sludge

Using a trowel, mark edges into the soil around the sample point per the sampling frame dimensions. Cut to depth and pick up the sample. Prior to homogenization, remove twigs, roots, leaves, rocks and miscellaneous debris (glass, bricks, etc.) from the sample using a decontaminated stainless-steel spoon or spatula. Return the debris to the sample location. NOTE: Removal of large stones, rocks, twigs, vegetation and other debris may result in a less than required volume of soil. It is recommended that at least 1.5 L (0.4 gallons) is collected to support analytical method requirements for a 1 L dry sample that is free of debris. Soil samples are collected only in the top 15 cm of soil.

Vegetation

Roll over the opening of a plastic bag (sample container). NOTE: Rolling over the top of the bag will provide a hand-hold for the bag (by allowing the bag to be grasped from under the rolled area), prevent the possible spread of contamination, and ease cleanup during final sample container closing. Use scissors or cutters to cut the material making sample pieces no longer than approximately 25 cm (10 inches). DO NOT cut by using exertion or "gnawing" away at the stalk. Place the retrieved sample in the plastic bag. The required amount for samples of vegetation is 1 kg

(2.2 pounds) or approximately 6.5 L (1.7 gal) of solid packed, low density (0.6 g/mL) vegetation (leafy material such as grass).

Swipe

Filters and swipes are used to collect samples from surface areas. These collection materials are composed of cotton fiber, plastic, glass fiber, or paper. Sizes depend on the surface area to be sampled and include:

- Small (standard) surface area (e.g., desk top) – 100 cm^2 (16 $inches^2$)
- Surfaces greater than 100 cm^2 should be swiped in various, random locations using multiple swipes to cover approximately 1% of the surface area.

Envelopes made of paper or glassine (transparent paper coated with a glaze), with and without sealing capabilities (either gummed or self-adhesive), are used to contain swipes and documentation.

Gamma Emitters

A gamma ray is a packet of electromagnetic energy (photon) emitted by the nucleus of some radionuclides following radioactive decay. Gamma photons are the most energetic photons in the electromagnetic spectrum. Gamma rays are a form of electromagnetic radiation (EMR). They are similar to X-rays, distinguished only by the fact that they are emitted from an excited nucleus. Electromagnetic radiation can be described in terms of a stream of photons, which are massless particles each travelling in a wave-like pattern and moving at the speed of light. Each photon contains a certain amount (or bundle) of energy, and all electromagnetic radiation consists of these photons. Gamma ray photons have the highest energy in the EMR spectrum and their waves have the shortest wavelength.

Scientists measure the energy of photons in electron volts (eV). X-ray photons have energies in the range 100 eV to 100,000 eV (or 100 keV). Gamma-ray photons generally have energies greater than 100 keV. For comparison, ultraviolet radiation has energy that falls in the range from a few electron volts to about 100 eV and does not have enough energy to be classified as ionizing radiation. The high energy of gamma rays enables them to pass through many kinds of materials, including human tissue. Very dense materials, such as lead, are commonly used as shielding to slow or stop gamma rays.

Gamma Emitting Radioisotopes

Barium-140 (^{140}Ba) is one of the γ-ray emitting isotopes in fallout and is produced in nuclear reactors. It has a physical half-life of 12.8 days. It decays to lanthanum-140 which emits γ-rays and has a physical half-life of 40.3 hours. Barium-140 contributes approximately 10% of the total fission product activity at 10 days and 30 days after production. About 12% of the total radioactivity of fission products aged for 10 or 30 days after production is lanthanum-140. Therefore, barium-140 and its daughter contribute significantly to that portion of the fall-out radiation dose caused by radionuclides of short or intermediate half-lives.

Cobalt-58 (^{58}Co) is one of the radioisotopes which is developed for the preparation of labelled compounds. It has a half life of 70.86 days.

Cobalt-60 (^{60}Co) is a synthetic radioactive isotope of cobalt with a half-life of 5.2713 years. It is produced artificially in nuclear reactors. Deliberate industrial production depends on neutron activation of bulk samples of the monoisotopic and mononucleic cobalt isotope cobalt-59. Measurable quantities are also produced as a by-product of typical nuclear power plant operation and may be detected externally when leaks occur. In the latter case (in the absence of added cobalt) the incidentally produced Co-60 is largely the result of multiple stages of neutron activation of iron isotopes in the reactor's steel structures via the creation of its Co-59 precursor. The simplest case of the latter would result from the activation of iron-58. Cobalt-60 decays by beta decay to the stable isotope nickel-60.

Cesium-134 (^{134}Cs) is one of the longest-lived radioisotopes with a half life of 2.0652 years. It is produced both directly as a fission product and via neutron capture from nonradioactive ^{133}Cs, which is a common fission product.

Cesium-137 (^{137}Cs) is a soft, flexible, silvery-white metal that becomes liquid near room temperature, but easily bonds with chlorides to create a crystalline powder. It is produced spontaneously when other radioactive materials such as uranium and plutonium absorb neutrons and undergo fission. Cesium-137 has a half life of 30.17 years.

Iron-59 (^{59}Fe) has been produced through the reactions of iron-58, iron-59, and cobalt-59. It has a half life of 47 days.

Iodine-131 (^{131}I) is a radioisotope with a very short half-life of 8.02 days, making it highly radioactive. Frequently used in small doses in thyroid cancers therapies, it is also one of the most feared fission products when accidentally released into the environment. The radioactive toxicity of iodine 131 is measured by an 'ingestion dose conversion factor' which allows to calculate the effective dose resulting from the ingestion of a given activity of a radioelement.

Indium-111 (^{111}In) is commonly used in nuclear medicine diagnostic imaging by radio-labeling targeted molecules or cells. It decays by electron capture to cadmium-111 with a half life of 2.8 days.

Potassium-40 (^{40}K) is a radioisotope that can be found in trace amounts in natural potassium, is at the origin of more than half of the human body activity: undergoing between 4 and 5,000 decays every second for an 80 kg man. Along with uranium and thorium, potassium contributes to the natural radioactivity of rocks and hence to the Earth heat. This isotope makes up one ten thousandth of the potassium found naturally. In terms of atomic weight, it is located between two more stable and far more abundant isotopes (K-39 and K-41) that make up 93.25% and 6.73% of the Earth total potassium supply respectively. With a half-life of 1,251 billion years, K-40 existed in the remnants of dead stars whose agglomeration has led to the Solar System with its planets.

Lanthanum-140 (^{140}La) has been detected as a fission product in snow after nuclear test explosions. It is concentrated commercially by crystallization of ammonium lanthanum nitrate. Lanthanum-140 has a half life of 40 hours.

Manganese-54 (^{54}Mn) is a synthetically produced isotope of manganese with atomic number of 25, it has a physical half life of 312.5 days and emits a single gamma ray at 834.8 keV.

Niobium-95 (^{95}Nb) is a fission product with a half life of 35 days. It is the decay product of ^{95}Zr, so disappearance of ^{95}Nb in used nuclear fuel is slower than would be expected because of the half life.

Technetium-99 metastable (^{99m}Tc) is a metastable nuclear isomer of technetium-99 (itself an isotope of technetium), symbolized as ^{99m}Tc, that is used in tens of millions of medical diagnostic procedures annually, making it the most commonly used medical radioisotope in the world.

Technetium-99m is used as a radioactive tracer and can be detected in the body by medical equipment (gamma cameras). It is well suited to the role, because it emits readily detectable gamma rays with a photon energy of 140 keV (these 8.8 pm photons are about the same wavelength as emitted by conventional X-ray diagnostic equipment) and its half-life for gamma emission is 6.0058 hours (meaning 93.7% of it decays to ^{99}Tc in 24 hours). The relatively "short" physical half-life of the isotope and its biological half-life of 1 day (in terms of human activity and metabolism) allows for scanning procedures which collect data rapidly but keep total patient radiation exposure low. The same characteristics make the isotope suitable only for diagnostic but never therapeutic use.

Zinc-65 (^{65}Zn) is produced through deuteron bombardment of zinc and has a half life of 250 days. This isotope appears to decay by electron capture and also, to a lesser extent, by positron emission.

Zirconium-95 (^{95}Zr) is one of the γ-ray emitting isotopes in fall-out, has a physical half-life of 65 days. It decays to niobium-95 which emits γ-rays and has a physical half-life of 35 days. Therefore, both these isotopes contribute to the total radiation hazard of fall-out. During the first year, these two isotopes share no less than 20 per cent of the total activity of fission products aged from a few days to one year. A knowledge of the metabolism of the parent isotope (zirconium-95) in relation to that of the daughter (niobium-95) is essential in order to estimate the total internal radiation hazard due to ^{95}Zr–^{95}Nb because the parent and the daughter decay at different rates. Further, the photopeak energies of zirconium-95 (0.72 MeV) and niobium-95 (0.764 MeV) are so close to one another that it is not possible to resolve and identify the individual photopeaks of the parent and daughter isotopes by γ-scintillation spectrometry.

Reporting and Interpretation of Results

Air samples are reported in picocuries per cubic meter. Water, dairy, and other liquid samples are reported in becquerel per liter or picocuries per liter. Soil, solid, sediment, and vegetation samples are reported in becquerel per gram or picocuries per gram. Swipe samples are reported in disintegration per minute per swipe. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email.

Tritium

Tritium is a beta-emitting radioactive isotope of hydrogen. Its nucleus consists of one proton and two neutrons, making it three times as heavy as a typical hydrogen nucleus (with its one proton) and one-and-a-half times as heavy as deuterium (which contains one proton and only one neutron). The half-life of the unstable tritium nucleus is 12.3 years, which is very short on the radioactive time-scale. This comparatively fast disappearance means that very little tritium can accumulate in any place.

Reporting and Interpretation of Results

Water samples are reported in picocuries per liter. Soil, solid, sediment, and vegetation samples are reported in picocuries per gram. Swipe samples are reported in disintegration per minute per swipe. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email.

Carbon-14

The nucleus of carbon-14 contains 6 protons and 8 neutrons, as opposed to the 6 and 6 found in ordinary carbon-12. The imbalance makes carbon-14 a radioisotope with a half-life of 5,700 years, and an emitter of beta particles. This radioactive isotope of carbon is called radiocarbon. The carbon-14 found in nature is constantly being regenerated by cosmic rays hitting the atmosphere. The rate at which the regeneration takes place has gone virtually unchanged for centuries; a feature which depends on the flux of particles bombarding the earth, and the strength of the magnetic field capable of diverting them. This magnetic shield, and consequently the particle flux, has slowly changed over time, and the quantity of carbon-14 formed on Earth changes with it.

Reporting and Interpretation of Results

Water samples are reported in picocuries per liter. Swipe samples are reported in disintegration per minute per swipe. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email.

Gross Alpha Radiation

Alpha (α) radiation was first observed as an unknown type of ray that curved in the presence of electric and magnetic fields. The direction of curvature revealed that it had to be carried by particles carrying positive electrical charge, and in 1908 Ernest Rutherford was able to identify these 'alpha particles' as helium nuclei, with a resulting electric charge of +2e. Later it was found, after the neutron's, discovery that the helium nucleus consists of 2 protons and 2 neutrons. The emission of alpha particles is a property of the heaviest nuclei, such as uranium-238 with its 92 protons and 136 neutrons, the heaviest natural nucleus observed. These unstable nuclei emit a light helium nucleus in order to reduce their mass and hence increase their stability. It turns out that expelling two protons and two neutrons in this manner is more energy efficient than expelling the four particles individually.

Reporting and Interpretation of Results

Air samples are reported in picocuries per cubic meter. Water samples are reported in picocuries per liter. Soil, Solid, Sediment, and Vegetation samples are reported in picocuries per gram. Swipe samples are reported in disintegration per minute per swipe. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email.

Gross Beta Radiation

Gross beta particle activity is a measure of the total amount of radioactivity in a water sample attributable to the radioactive decay of beta-emitting elements. Beta particles usually travel greater distances in air than alpha particles (about 6 feet) before being absorbed.

Reporting and Interpretation of Results

Air samples are reported in picocuries per cubic meter. Water samples are reported in picocuries per liter. Soil, Solid, Sediment, and Vegetation samples are reported in picocuries per gram. Swipe samples are reported in disintegration per minute per swipe. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email.

Radon

Radon is a naturally occurring radioactive gas that is produced during the radioactive decay processes of uranium and thorium in the Earth's crust. It can accumulate in homes and buildings to concentrations that can increase the potential for developing lung cancer.

Collection

Radon test kits consist of a self-contained activated charcoal adsorber. The kits are mailed to any requesting individual, deployed by the individual following the provided instructions, and then returned to the manufacturer for analysis. The manufacturer provides analysis results to both the individual who submitted the test, and to ADHS-BRC. Results are reported in picocuries per liter of air.

Reporting and Interpretation of Results

ADHS-BRC provides approximately 400 radon test kits to Arizona residents per year. The kits are shipped directly from the resident to a third-party laboratory, Air Chek Inc., where they are then analyzed. The submitting agency may be notified of results via telephone or e-mail once results are confirmed. A final report containing sample results may be sent by mail or email by ADHS-BRC and/or Air Chek Inc.

Section 6: Sample Submission Guidelines – Chemical Emergency Response

The Centers for Disease Control and Prevention (CDC) originally established the Laboratory Response Network – Chemical (LRN-C) to respond to chemical exposure events and emergencies and have provided instructions on packaging and shipping specimens in the event of such an emergency. Submitters should make every effort to follow these instructions when submitting samples to the ADHS Laboratory during a chemical exposure event. Please contact the Chemical Emergency Response section (602) 542-6116 or (602) 739-6105 for further instructions and guidance.

Patient samples may also be submitted to the laboratory under non-emergency exposure situations. Instructions for both types of scenarios are described below.

Specimen Collection and Labeling

- ❖ Please refer to the Specimen Collection Graphic Instructions (Appendix A) for illustrative examples.
- ❖ Specimen labels must contain the patient's first and last name or a unique patient ID number.
- ❖ Refer to the Quick Reference Chart (or the method narrative guidelines) for more information on method-specific sample container types and volumes.
- ❖ Any person suspected of exposure during an emergency chemical exposure event situation should have a full set of samples collected (blood and urine). If a complete set of samples is not obtainable, the submitter should contact the ADHS laboratory. Sample analysis will be performed on a case-by-case basis.

Whole blood

- Blood tubes should be vacuum-fill only (unopened), non-gel and not expired.
- A complete set of blood samples should be submitted as described below:
  - Collect blood specimens from adults only unless you receive specific instruction from ADHS to collect blood from pediatric patients.
  - Use 4-mL or larger tubes, and allow each tube to fill to its stated capacity.
  - Collect three purple-top (EDTA) tubes and one green- or gray-top (heparin) tube. If using 3-mL tubes, collect four purple-top tubes.
  - Using indelible ink, mark each purple-top tube of blood ***in the order collected*** (e.g., #1, #2, #3, #4 [if using 3-mL tubes]).
- Refrigerate blood samples at 5 ± 3 °C until they are submitted to the ADHS laboratory. DO NOT FREEZE.
- For each lot number of blood tubes used for collection, please provide two (2) empty, unopened purple-top tubes and/or two (2) empty, unopened green- or gray-top tubes to be used as blanks for measuring background contamination.

Urine

- A sample consisting of 40-60 mL of urine should be collected from potentially exposed adults and children.
- A minimum of 5 mL is required for each test requested (refer to the method narrative guidelines for additional information).
- If less than the ideal sample volume is able to be submitted, the submitter should contact the ADHS Laboratory; sample analysis will be performed on a case-by-case basis.
- The ideal sample collection container is a screw-cap plastic urine cup with a maximum capacity of 80-100 mL. Do not overfill the container.
- Freeze specimen as soon as possible or store on dry ice until shipment to the ADHS Laboratory.
- If other than "clean catch", note method of collection on the specimen cup (e.g., obtained by catheterization).
- For each lot number of urine cups used for collection, please provide two (2) empty, unopened urine cups to be used as blanks for measuring background contamination.

Labeling Specimens

- Label specimens with labels generated by your facility and follow your facility's procedures for proper specimen labeling.
- In addition to unique patient identifiers (e.g., medical records number, specimen identification number) labels should convey the collector's initials, date and time of collection so that law enforcement officials may trace the specimen to the collector should investigations lead to legal action and the collector has to testify that he or she collected the specimen.
- If you use bar-coded labels, place the labels on blood tubes and urine cups so that when these containers are upright, the bar code looks like a ladder. At this time, ADHS does not have the ability to read bar-coded labels. If you submit samples with bar codes, please include additional identifying information on the specimen label.
- Maintain a list of names with corresponding specimen identification numbers at the collection site so that results can be reported to patients. It is recommended that you record additional data for use in the interpretation of results. Additional data may include: time of potential exposure, method of urine collection if other than "clean-catch", indication if sample was collected post- mortem, and antidotes or other medical treatments administered prior to sample collection.

Packaging of Specimens

Packaging consists of the following components: primary receptacles (blood tubes or urine cups), secondary packaging (materials used to protect primary receptacles), and outer packaging (e.g., polystyrene foam-insulated, corrugated fiberboard shipper). Samples submitted via air transportation (such as FedEx, UPS, or USPS) have different packaging requirements than those submitted via courier; instructions for both are provided below.

❖ Note: if the samples to be submitted are tied to a criminal investigation and/or pertain to an **emergency chemical exposure event situation**, special packaging instructions (e.g. use of evidence tape) may need to be followed. The Sample Packaging Graphics (Appendix B) contains illustrative examples of these instructions. Please contact the ADHS Laboratory for additional information.

Samples/Specimens Sent by Air Transportation

Primary Containers

- This is detailed in the previous section (Specimen Collection and Labeling). Refer to the Quick Reference Chart (or the method narrative guidelines) for more information on method-specific sample container types and volumes.
- Sample containers must be securely sealed and leak-proof.
- Samples must be properly labeled with patient identifying information.

Secondary Packaging

- To facilitate processing, package all blood tubes from the same patient together.
- If both blood and urine samples are being submitted from the same patient, they must be packaged separately, as they have different temperature requirements.
- The secondary container must be securely sealed and watertight/leak-proof.
    - Note: The primary OR secondary container must be pressure and temperature capable (95 kPa) if air transportation is used. According to 49 CFR 173.199(b), if specimens are to be transported by air, either the primary receptacle or the secondary packaging used must be capable of withstanding, without leaking, an internal pressure producing a pressure differential of not less than 95 kPa (0.95 bar, 14 psi). Verify in advance that the manufacturer of either the blood tube or secondary packaging used in your facility is in compliance with the pressure differential requirement.
- Place absorbent material between the blood tubes or urine cups and the first layer of secondary packaging. Use enough absorbent material to absorb the entire contents of the blood tubes.
    - Separate each tube of blood collected from other tubes, or wrap tubes to prevent tube- to-tube contact. Some ways to do this are to:
        - Pack blood tubes in a gridded box lined with absorbent material.
        - Pack a sealable polystyrene foam container or blood tube shipment sleeve and transport tube with individually wrapped tubes.
    - Separate each urine cup from other urine cups, or wrap individual urine cups to prevent contact between urine cups. Examples of some ways to do this are to:
        - Pack urine cups in a gridded box lined with absorbent material.
        - Seal individually wrapped urine cups inside a clear, leak-proof biohazard polybag equivalent to Saf-T-Pak product STP-701, STP-711 or STP-731.

- Seal one gridded box or alternative container inside a clear, leak-proof biohazard polybag equivalent to Saf-T-Pak product STP-711, STP-731, or STP-741.
- Place this bag inside a white Tyvek® outer envelope (or equivalent) and seal the opening. An example of acceptable material is the Saf-T-Pak Disposable 2-Part Pressure Vessel system (Saf-T-Pak product STP-710, STP-730, or STP-740).
- A completed itemized list of contents must be placed outside of, or surrounding the secondary container. Do not place this paperwork around the primary container as it may be compromised if the primary container leaks or is broken. Refer to the Preparing Documentation section for further information.
    - Note: An ADHS Clinical Sample Submission Form will satisfy this requirement.
- Keep any chain-of-custody documents for your files; do not include them with the samples. A new chain-of-custody will be started upon receipt of samples by ADHS.

Tertiary/Outer Packaging

- Outer package must be rigid and of good quality (e.g., polystyrene foam-insulated, corrugated fiberboard shipper). This may be available from your transfusion service or send-outs department.
- Package the specimen with enough absorbent material for the entire contents as well as additional cushioning material to help prevent breakage.
- Blood and urine samples <u>cannot</u> be shipped together:
    - Package blood samples with cold packs – they must not be allowed to freeze, but must maintain a shipping temperature of 1 °C – 10 °C for the duration of transit.
    - Package urine samples using dry ice if possible to ensure that samples freeze and remain frozen during shipment. Do not use large chunks of dry ice for shipment because these have the potential for shattering urine cups during transport. Add enough dry ice to ensure that specimens remain frozen for the duration of transit.
- Place a **UN 3373** label and the words "Biological Substance, Category B" on the front of the shipper.
- For urine samples being shipped on dry ice, place a **Class 9/UN 1845** hazard label on the same side of the shipper as the UN 3373 marking. Note the weight of dry ice (in kg) that is contained in the shipper (1 pound is approximately 0.45 kg).
- Place your return address in the upper left-hand corner of the shipper top and put ADHS's receiving address in the center (see below).
- If the shipper will be transported by a commercial air carrier, complete an airway bill. On the airway bill, note the proper shipping name and UN number for each hazardous material and identify a person responsible for the shipper per IATA packing instruction 650.
    - Full name, complete address and phone number of shipper (responsible person).
    - Full name, complete address and phone number of recipient.

Samples/Specimens Sent by Courier

Primary Containers

- This is detailed in the Specimen Collection and Labeling section. Refer to the Quick Reference Chart (or the method narrative guidelines) for more information on method-specific sample container types and volumes.
- Sample containers, as well as secondary packaging, must be securely sealed and leak-proof.
- Samples must be properly labeled with patient identifying information.

Secondary Packaging

- To facilitate processing, package all blood tubes from the same patient together.
- Place absorbent material between the blood tubes or urine cups and the first layer of secondary packaging. Use enough absorbent material to absorb the entire contents of the primary container. Note: it is acceptable to send more than one specimen together, as long as they are properly secured and identified.
    - Separate each tube of blood collected from other tubes, or wrap tubes to prevent tube- to-tube contact. Some ways to do this are to:
        - Pack blood tubes in a gridded box lined with absorbent material.
        - Pack a sealable polystyrene foam container or blood tube shipment sleeve and transport tube with individually wrapped tubes.
    - Separate each urine cup from other urine cups, or wrap individual urine cups to prevent contact between urine cups. Examples of some ways to do this are to:
        - Pack urine cups in a gridded box lined with absorbent material.
        - Seal individually wrapped urine cups inside a clear, leak-proof biohazard polybag equivalent to Saf-T-Pak product STP-701, STP-711 or STP-731.
- Specimen(s) should then be placed in a secondary container such as a plastic specimen bag with separate compartments for the sample paperwork and specimen (such as Saf-T-Pak product STP-711, STP-731 or STP-741).
    - Do not place the paperwork in the same compartment as the specimen(s).
    - A completed itemized list of contents (such as a manifest) must be placed outside of, or surrounding the secondary container. An ADHS Sample Submission Form will satisfy this requirement.
    - Refer to the Preparing Documentation section on the next page for further information.

Tertiary/Outer Packaging

- Samples should preferably be submitted with cold packs or dry ice, if possible.
- All infectious material must be triple-packaged and conform to DOT requirements.

Shipment of Samples

Please ship specimens to the following address:

Arizona State Public Health Laboratory
Attn: Cheryl Peyton/Chemical Emergency Response
250 N. 17th Avenue
Phoenix, Arizona 85007
(602) 739-6105
(480) 904-4040

Preparing Documentation – Sample Submission Forms

- All samples submitted to ADHS for analysis should have sample submission forms completed for each patient. A copy of the ADHS Clinical Chemistry Sample Submission Form may be found at https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php#forms-clinical
- Each submission form must include the name of the submitting agency as well as the contact person, including phone number.
- The following information must be recorded on the submission form for each patient:
    - Patient name or other unique identifier
    - Date and time of collection
    - Source of specimen (e.g. blood, serum, or urine)
    - Patient's sex
    - Patient's age or date of birth
    - Test(s) to be performed – See note below for unknown analysis
- Note: if the test(s) to be performed are not known (such as may be the case in a **chemical exposure event situation**), this should be indicated on the sample submission form. ADHS will proceed with sample analysis based on guidance from the CDC.
- A separate sample submission form should be filled out for each specimen source (i.e., one submission form for blood samples, and another for urine samples).
- Do not transport chain-of-custody forms with specimens. Each entity or organization handling the specimens is responsible for the specimens only during the time that it has control of the specimens.
- Each entity or organization receiving the specimens must sign-off on the chain-of-custody form of the entity or organization relinquishing the specimens to close that chain.
- When receiving specimens, each new entity or organization must begin its own chain of custody. The entity or organization relinquishing the specimens must sign its chain of custody to close the chain and indicate that they have transferred the specimens.

  Note: When the person relinquishing the specimens (relinquisher) and the person receiving the specimens (receiver) are not together at the time of specimen transfer, the relinquisher must document on its chain-of-custody form that the receiver is the express courier (e.g.,

FedEx, Delta Dash, DHL, UPS) and must document the shipment tracking number or have the person transporting the specimens sign the chain-of-custody to indicate that he or she has taken control of the specimens. Likewise, when receivers get the specimens, they will document on their chain-of- custody form that the relinquisher is the express courier (and provide the tracking number) or have the person transporting the specimens sign the chain-of-custody form.

- A new chain of custody form will be initiated once samples are received by ADHS.

Section 7: Sample Submission Guidelines – Public Health Chemistry

Packaging of Samples

Primary Container

- Refer to the Quick Reference Chart (or the method narrative guidelines) for more information on method-specific sample container types and volumes.

Outer Container

- Sample containers, as well as secondary packaging, must be securely sealed and leak-proof.
- A completed itemized list of contents must be placed outside of, or surrounding the secondary container. A Public Health Chemistry Sample Submission Form will satisfy this requirement.
- Do not place the paperwork in the same compartment as the primary container as it may be compromised if the primary container leaks or is broken.
- Keep any chain-of-custody documents for your files. A new chain-of-custody will be started upon receipt of samples by ADHS.
- Samples are transported to the laboratory after sampling. If shipped, samples are shipped using approved ADOT guidelines.

Shipment of Samples

Specimens should be shipped to:

Arizona State Public Health Laboratory
Attn: Public Health Chemistry
250 N. 17th Avenue
Phoenix, Arizona 85007
(602) 542-6116

Preparing Documentation – Sample Submission Forms

- All samples submitted to ADHS for analysis should include completed sample submission forms. A copy of the Public Health Chemistry Sample Submission Form may be obtained at https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php#forms-water-soil
- Each submission form must include the name of the submitting agency as well as the submitter's contact information (including name and phone number).

Section 8: Sample Submission Guidelines – Food Emergency Response Network (FERN)

Packaging of Samples

Primary Container

- The primary container is the receptacle that contains the food sample. The sample should be sequestered from the other samples either in a glass/plastic bottle or plastic bag. It is preferable that the original packaging be the primary container and sealed in a plastic bag.

Outer Container

- Outer package must be rigid and of good quality (e.g., polystyrene foam-insulated, corrugated fiberboard shipper).

Samples/Specimens Sent by Courier

- Sample containers, as well as secondary packaging, must be securely sealed and leak-proof.
- Courier must have itemized list of samples being submitted.
- Submitter has the option of requesting chain of custody. Samples submitted through a courier must be sealed and the seal signed by the collector/submitter.

Shipment of Samples

Specimens should be shipped to:

Arizona State Public Health Laboratory
Attn: Food Emergency Response Network – Chemistry
250 N. 17th Avenue
Phoenix, Arizona 85007
(602) 364-1125

Preparing Documentation – Sample Submission Forms

- All samples submitted to ADHS for Food analysis should include completed sample submission forms. A copy of the ADHS Chemistry Food Analysis Submission Form may be obtained at https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php#forms-food
- Each submission form must include the name of the submitting agency as well as the contact person, including phone number and/or email.

Section 9: Sample Submission Guidelines – Toxicology

Specimen Collection

Blood specimens should be collected aseptically in an appropriate collection tube and labeled with a patient identifier (e.g. patient name). Follow the manufacturer's instructions for volume to collect for each tube submitted.

- **Whole Blood:** lavender top vacutainer tube with EDTA anticoagulant
- **Note:** specimen may also be submitted in gray-top vacutainer tube with Potassium Oxalate/Sodium Fluoride anticoagulant

Transportation & Storage:

Postmortem specimens:

- Samples can be refrigerated or frozen prior to shipment. Transportation of the specimen to ASPHL should be shipped on cold packs or wet ice to prevent damage to the specimen or loss of integrity of specimen due to high heats seen in the summer.
- Samples must be transported with the appropriate paperwork, verifying that the information appearing on the specimen matches that on the submission form. Since the integrity of the sample must be maintained from the time of collection of the sample until testing is completed, **labeling errors will result in rejection of the specimen**.
- Laboratory submission forms should be filled out completely with all pertinent demographic information. The following information must be recorded on the submission form for each sample:
    - First and last name of decedent
    - Date of birth
    - Date of death
    - Case number
    - Specimen type
    - Test(s) to be performed – Toxicology Forensic Panel, Fentanyl Analogues, and/or THC Metabolites
    - Chain of custody, if needed
- **In addition, the specimen must be labeled with either the patient name (first and last) or a unique identifier.**

Shipment of Samples

Samples submitted for Toxicology Surveillance Panel (opioids) testing are classified as Category B (UN3373) and must be transported to the Arizona State Public Health Laboratory according to appropriate IATA (International Air Transportation Association), USPS (United States Postal Service) and DOT (U.S. Department of Transportation) regulations.

A Forensic Toxicology Sample Submission Form must accompany every sample submitted for

testing. The form is available at https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php#forms-toxicology.

Category B shipments must follow Packaging Instruction (PI) 650. All samples and their containers must be identified with the appropriate labels, client and patient information. Any samples which are leaking and/or not properly identified will be rejected.

Specimens may be mailed or delivered by courier to the ASPHL. Submit all samples to the following location:

Arizona State Public Health Laboratory
Attn: Chemistry Toxicology
250 N. 17th Avenue
Phoenix, AZ 85007
(602) 542-1190

If Sent by Courier

- Blood sent in vacutainer tubes should first be placed in a leak proof primary container (such as a 50 mL plastic conical tube available from the ASPHL) to reduce the risk of shattering while in transit. Wrap with absorbent material sufficient for entire contents.
- The specimen should then be placed in a secondary container such as a plastic specimen bag with separate compartments for the submission form and specimen.
- Pack the specimen and its form in absorbent material to help prevent breakage.
    - **Note:** It is acceptable to send more than one specimen together, as long as they are properly secured and identified.
    - **Note:** Do **not** put the submittal form around the primary container; it must be around the secondary container.
- Place appropriate biohazard label on the outside of the secondary container before transportation to the ASPHL.
- All infectious material must be triple packaged and conform to U.S. Department of Transportation (DOT) requirements. For courier deliveries, the tertiary package can either be a cooler or a cardboard box with Styrofoam insert.
    - Post-mortem specimens may be frozen.
    - **Note:** It is recommended to place wet ice and/or ice packs inside a zip-lock bag and surround this with absorbent material.

If Sent by Mail

- Blood sent in vacutainer tubes should first be placed in a leak proof primary container (such as a 50 mL plastic conical tube available from the ASPHL) to reduce the risk of shattering while in transit. Wrap with absorbent material sufficient for entire contents.
- The specimen should then be placed in a secondary container such as a plastic specimen bag with separate compartments for the submission form and specimen.
    - **Note:** Primary **OR** secondary container must be pressure and temperature capable (95

kPa) if air transportation is used.

  - **Note:** Do **not** put the submittal form around the primary container; it must be around the secondary container.
  - If you have the appropriate materials you can place multiple primary containers inside a secondary container.

- Pack the specimen and its form in absorbent material to help prevent breakage. Place appropriate biohazard label on the outside of the secondary container before transportation to the ASPHL.
- Place the secondary container inside the tertiary container or cardboard mailer. Outer package must be rigid and of good quality. Package the specimen with enough absorbent material for entire contents and to help prevent breakage.
  - **Note:** It is recommended to place wet ice and/or ice packs inside a zip-lock bag and surround this with absorbent material.
  - If wet ice or ice packs are to be used for maintaining refrigerated shipping temperatures ensure there is sufficient absorbent material contained within to absorb all moisture if ice melts during transit so integrity of box is not compromised.
- All infectious material must be triple-packaged and conform to current shipping regulations. Consult the Domestic Mail Manual published by the US Post Office (USPS) for current USPS requirements, and the Hazardous Material Regulations (HMR) for current DOT requirements.
  - Outer package must be labeled with:
    - UN3373 Biological Substance, Category B diamond shaped hazard label.
    - Full name, complete address and phone number of shipper (responsible person).
    - Full name, complete address and phone number of recipient.
  - Do NOT affix biohazard symbol to outer package

50 mL conical tubes and cardboard mailers are available from the ASPHL Receiving section via the Request for Materials form available at https://www.azdhs.gov/preparedness/state-laboratory/shipping-receiving/index.php#forms-supply-order. Email the completed form to labreceiving@azdhs.gov. Please submit your orders in advance to ensure prompt service and delivery.

Appendix A

Chemical Emergency Response:
Specimen Collection Graphic Instructions

ADHS Specimen-Collection Protocol for a Chemical-Exposure Event

For detailed instructions see ADHS's *Shipping Instructions for Specimens Collected from People Who May Have Been Exposed to Chemical-Terrorism Agents.*

Collect blood and urine samples for each person involved in the chemical-exposure event.

Note: For children, collect only urine samples unless otherwise directed by ADHS.

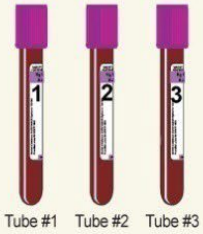
Blood-Sample Collection

For each person, collect blood in glass or plastic tubes in the following order: 1st: collect specimens in three (3) EDTA (purple-top) 4 mL or larger plastic or glass tubes; 2nd: collect another specimen in one (1) gray- or green-top tube. Collect the specimens by following the steps below:

1 Collect a minimum of 12 mL of blood in three (3) 4 mL or larger glass or plastic tubes. If using 3 mL tubes, use four tubes.

Do not use gel separators.

2 Mix contents of tubes by inverting them 5 or 6 times.



Tube #1 Tube #2 Tube #3

Label tubes in order of collection. #1, #2, #3

3 Place bar-coded labels on each tube, so that when the tubes are upright, the barcode looks like a ladder.

Tube #1 Tube #2 Tube #3

Store samples at 1°C to 10°C.
Do not freeze.

---

4 After collecting samples in the purple-top tubes, collect one (1) sample in a gray- or green-top tube (gray-top tube shown). Allow the tube to fill to its stated capacity.

Do not use gel separators.

5 Mix contents of the tube by inverting it 5 or 6 times.

6 Place bar-coded labels on the tube, so that when the tube is upright, the barcode looks like a ladder.

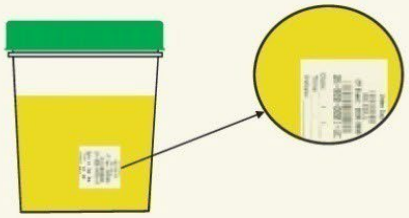
Store samples at 1°C to 10°C.
Do not freeze.

Urine-Sample Collection

For each person, collect 25 mL- 50 mL of urine in a screw-cap urine cup.

Label the urine cup with the appropriate bar-coded label as shown. Indicate on the cup how the sample was collected if the method was other than "clean catch" (i.e., catheterization).

Freeze samples (optimally at -70°C).



Place bar-coded labels on all cups so that when the cup is upright, the barcode looks like a ladder.

Appendix B

Chemical Emergency Response: Sample Packaging Graphics

Blood and Urine

ADHS

Instructions for Shipping Blood Specimens to Arizona Department of Health Services after a Chemical Exposure Event

Guidance in Accordance with Packaging Instructions International Air Transport Authority (IATA) 650 Biological Substance Category B

1

Place purple- and green-top tubes by patient number into gridded-type box lined with absorbent pad. If using an alternative packaging method, pack all tubes from the same patient together while preventing tube-to-tube contact.

2

Seal gridded box or alternative secondary container with one continuous piece of evidence tape. The individual making the seal must initial half on the evidence tape and half on the box or packaging.

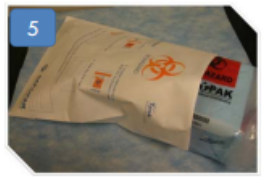
3

Wrap gridded box in an absorbent pad and tape to seal.

4

Seal gridded wrapped box or alternative container inside a Saf-T-Pak clear inner, leak-proof polybag (or equivalent).

5



Place the sealed Saf-T-Pak inner leak-proof polybag (or equivalent) inside a white Tyvek outer envelope (or equivalent).

Note: If primary receptacles do not meet the internal pressure requirement of 95 kPa, use compliant secondary packaging materials.

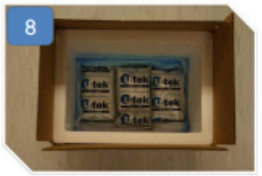
6

Seal the opening of this envelope with a continuous piece of evidence tape. Write initials half on the evidence tape and half on the envelope.

7

Use polystyrene foam insulated, corrugated fiberboard shipper to ship boxes to ADHS. Place absorbent material in the bottom of the shipper.

8



Place refrigerator packs in a single layer on top of the absorbent material.

Note: Blood tubes are to be shipped cold and not frozen.

9

Place the packaged specimens in the shipper. Use absorbent material or cushioning material to minimize shifting while box is in transit. Place additional refrigerator packs on top of samples.

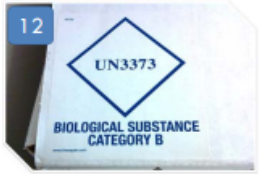
10

Place the blood shipping manifest in a sealable plastic bag and put on top of the sample boxes inside the shipper. Keep your chain-of-custody documents for your files. Place lid on shipper.

11

Secure the shipper lid with filamentous shipping tape. Place your return address in the upper left-hand corner of the shipper top and put the ADHS Laboratory receiving address in the center.

12



Add the UN 3373 label and the words "Biological Substance Category B" on the front of the shipper. UN 3373 is the code identifying the shipper's contents as "Biological Substance, Category B."

13

Send shipper via FedEx or transport directly via courier, police or other delivery to:

Arizona Department of Health Services
Chemical Emergency Response
Attn: Cheryl Peyton
250 N. 17th Ave
Phoenix, AZ 85007

For questions concerning this process or to request packaging and shipping materials, please contact:

Arizona Department of Health Services
Chemical Emergency Response
Attn: Cheryl Peyton
250 N. 17th Ave
Phoenix, AZ 85007

Office: (602) 542-6116
After Hours: (602) 739-6105

LRN
LABORATORY RESPONSE NETWORK

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

ADHS

Instructions for Shipping Urine Specimens to Arizona Department of Health Services after a Chemical Exposure Event

Guidance in Accordance with Packaging Instructions International Air Transport Authority (IATA) 650 Biological Substance Category B

1

Use a gridded box or individually wrapped cups sealed with evidence tape to separate urine cups. Place absorbent material in the bottom of the box and insert the cups.

2

Use one continuous piece of evidence tape to seal the gridded box or Saf-T-Pak inner leak-proof polybag (or equivalent) containing wrapped urine cup(s). The individual making the seal must initial half on the evidence tape and half on the box or bag.

3

Wrap gridded box in an absorbent pad and tape to seal. Seal gridded wrapped box or alternative container inside a Saf-T-Pak clear inner, leak-proof polybag (or equivalent).

4

Place the sealed Saf-T-Pak inner leak-proof polybag (or equivalent) inside a white Tyvek outer envelope (or equivalent).

Note: If primary receptacles do not meet the internal pressure requirement of 95 kPa, use compliant secondary packaging materials.

5

Seal the opening of this envelope with a continuous piece of evidence tape. Write initials half on the evidence tape and half on the envelope.

6

Use polystyrene foam insulated, corrugated fiberboard shipper to ship boxes to ADHS. Place absorbent material in the bottom of the shipper.

7

Place a layer of dry ice in the bottom of the shipper on top of the absorbent material. DO NOT use large chunks or flakes of dry ice.

Note: Urine cups are to be frozen.

8

Place the packaged specimens in the shipper. Use absorbent material or cushioning material to minimize shifting while box is in transit. Place additional dry ice on top of samples.

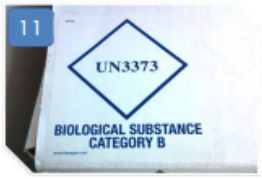
9

Place the urine shipping manifest in a sealable plastic bag and put on top of the sample boxes inside the shipper. Keep your chain-of-custody documents for your files. Place lid on shipper.

10

Secure the shipper lid with filamentous shipping tape. Place your return address in the upper left-hand corner of the shipper top and put the ADHS Laboratory receiving address in the center.

11



Add the UN 3373 label and the words "Biological Substance Category B" on the front of the shipper. UN 3373 is the code identifying the shipper's contents as "Biological Substance, Category B."

12

Place a Class 9/UN 1845 label on front of shipper. This label for dry ice *MUST* indicate the weight of dry ice (in kg) within shipper and the proper name (dry ice or solid carbon dioxide).

13

Send shipper via FedEx or transport directly via courier, police or other delivery to:

Arizona Department of Health Services
Chemical Emergency Response
Attn: Cheryl Peyton
250 N. 17th Ave
Phoenix, AZ 85007

For questions concerning this process or to request packaging and shipping materials, please contact:

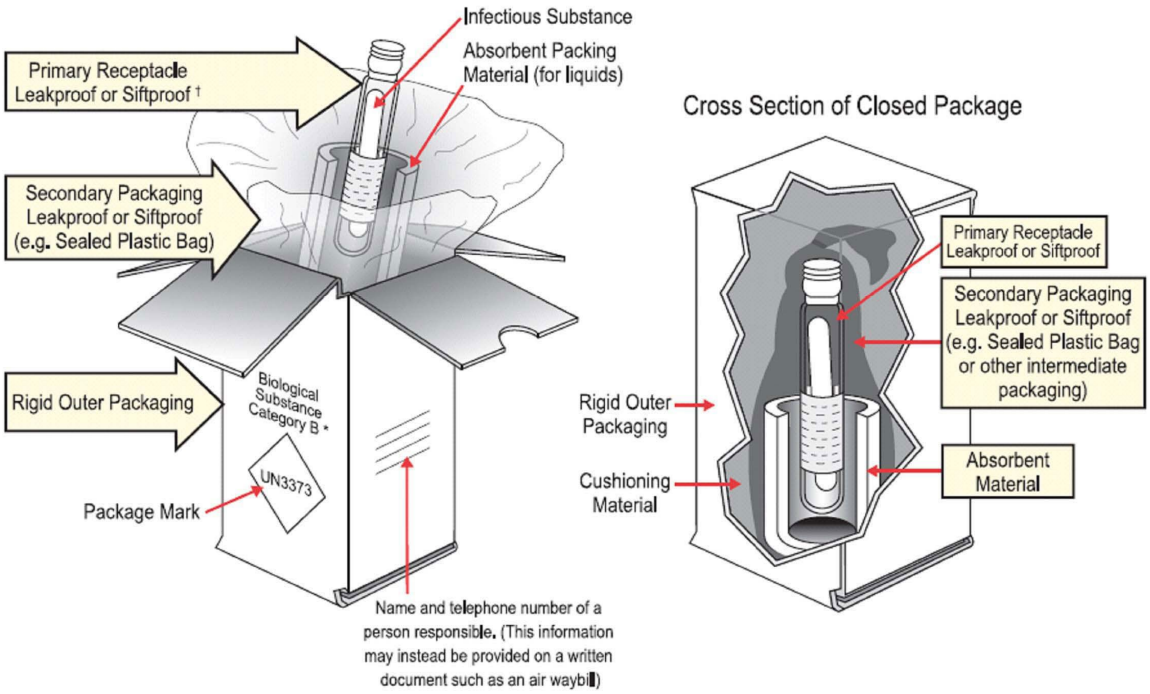
Arizona Department of Health Services
Chemical Emergency Response
Attn: Cheryl Peyton
250 N. 17th Ave
Phoenix, AZ 85007

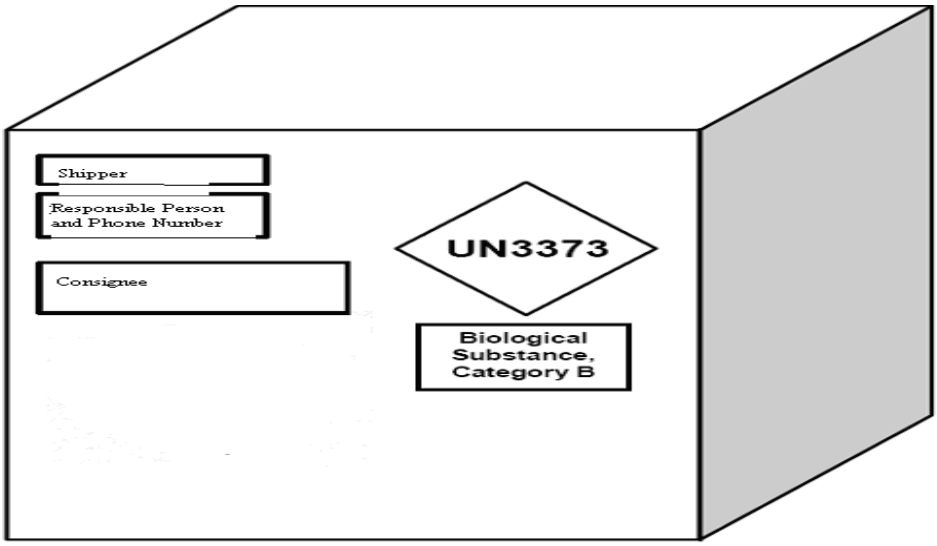
Office: (602) 542-6116
After Hours: (602) 739-6105

LRN
LABORATORY RESPONSE NETWORK

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Category B Shipping Examples





A completely labeled outer package. The primary container inside the package contains a Biological Substance, Category B substance and is packed according to PI 650.

Sample ID:_____
Packager Name/Initial:_____
Date:_____

CATEGORY B CHECKLIST

-UN 3373 Biological Substances, Category B
-IATA Packing Instruction (PI) 650
-FedEx, UPS, USPS (Us Mail), private couriers

Primary:

- ☐ Specimen properly labeled with patient ID information
- ☐ 50mL or 50g maximum quantity
- ☐ Securely sealed & watertight/leakproof (screw cap receptacle and parafilm)
  Note: a Petri dish is not an acceptable primary container
- ☐ Wrapped in absorbent material sufficient for entire contents
- ☐ Wrapped in cushioning material (bubble wrap)
  - ☐ Primary **OR** secondary container pressure and temperature capable (95kPa)

Secondary:

- ☐ Securely sealed and watertight/leakproof
  - ☐ Primary **OR** secondary container pressure and temperature capable (95kPa)
- ☐ A completed itemized list of contents (requisition or sample submission form) is placed between the secondary packaging and the outer packaging (NOT inside the secondary packaging)
- ☐ Absorbent material is placed between the primary and secondary packaging
- ☐ Biohazard symbol on secondary package required if shipping via US Mail (USPS)
- ☐ (Optional) Additional cushioning material placed between primary and secondary

Outer Package (Rigid):

- ☐ Package is rigid and of good quality (acceptable to reuse Category B packages)
- ☐ UN 3373 Biological Substances, Category B diamond shaped label
- ☐ Quantity of infectious material is listed
- ☐ Quantity of sample –volume (mL) or weight (g)
- ☐ Must not contain more than 4 L, 4000mL or 4kg
- ☐ Do NOT put biohazard symbol on outer package
- ☐ Full name, complete address and phone number of person responsible for the shipment
  (This can be either the shipper or the recipient, but must be someone knowledgeable of the contents)
- ☐ Full name, complete address and telephone number of the shipper
- ☐ Full name, complete address and telephone number of the consignee/recipient

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NOTE: A Shipper's Declaration is not needed for Category B samples OR if dry ice is used.

If dry ice is used consult dry ice shipping checklist
If overpack is used consult overpack shipping checklist