ATTACHMENT A

CALIBRATION AND CORRECTIVE ACTION PROCEDURES, QUALITY CONTROL ACCEPTANCE CRITERIA, AND METHOD DETECTION AND PRACTICAL QUANTITATION LIMITS

TABLE A1-a(1)

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8260B
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Control Limits[b] Accuracy Percent Recovery (%) Water (µg/l)	Control Limits[b] Precision (RPD %) Water
Matrix Spike/Matrix Spike Duplicate Samples			
SW-846 8260B	Spiking Compounds[b]		
	1,1-Dichloroethene	68-133	20
	Benzene	77-118	20
	Chlorobenzene	78-118	20
	Toluene	73-120	20
	Trichloroethene	78-122	20
	1,3-Dichlorobenzene	75-115	20
	1,1-Dichloroethane	77-117	21
	1,2-Dichloropropane	76-116	20
	Chloroform	78-118	20
	Ethylbenzene	78-118	26
	Tetrachloroethene	77-117	20
	1,1,1-Trichloroethane	78-118	20
	Carbon Tetrachloride	80-120	21
	Trans-1,2-Dichloroethene	80-120	24
	Methylene Chloride	71-119	20
	Bromodichloromethane	78-118	20
	Surrogate Spikes		
	Dibromofluoromethane	79-120	NA
	1,2-Dichloroethane-d4	65-126	NA
	Toluene-d8	78-120	NA
	4-Bromofluorobenzene	75-120	NA
Laboratory Control Samples			
SW-846 8260B	Spiking Compounds		
	1,1-Dichloroethene	68-133	NA
	Benzene	77-118	NA
	Chlorobenzene	78-118	NA
	Toluene	73-120	NA

TABLE A1-a(1)

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8260B
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION
(CONTINUED)

Analytical Method[a]	Spiking Compounds	Control Limits[b] Accuracy Percent Recovery (%) Water (µg/l)	Control Limits[b] Precision (RPD %) Water
Laboratory Control Samples (continued)			
SW-846 8260B	Spiking Compounds[b]		
	Trichloroethene	78-122	NA
	1,3-Dichlorobenzene	75-115	NA
	1,1-Dichloroethane	77-117	NA
	1,2-Dichloropropane	76-116	NA
	Chloroform	78-118	NA
	Ethylbenzene	78-118	NA
	Tetrachloroethene	77-117	NA
	1,1,1-Trichloroethane	78-118	NA
	Carbon Tetrachloride	80-120	NA
	Trans-1,2-Dichloroethene	80-120	NA
	Methylene Chloride	71-119	NA
	Bromodichloromethane	78-118	NA
	Surrogate Spikes		
	Dibromofluoromethane	79-120	NA
	1,2-Dichloroethane-d4	65-126	NA
	Toluene-d8	78-120	NA
	4-Bromofluorobenzene	75-120	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) The control limits listed are subject to change. The limits are statistically derived and are regularly adjusted to match operating conditions. Depending on analyte list, reported spiking compounds may not include all listed above.

TABLE A1-a(2)

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8260C
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Control Limits[b] Accuracy Percent Recovery (%) Water	Control Limits[b] Precision (RPD %) Water
Matrix Spike/Matrix Spike Duplicate Samples			
SW-846 8260C	Spiking Compounds		
	1,2-Dichloroethane	39-162	25
	Chloroform	50-146	25
	Methylene chloride	65-135	25
	Surrogate Spikes		
	1,2-Dichloroethane-d4	77-144	NA
	Dibromofluoromethane	80-124	NA
	Toluene-d8	80-125	NA
	4-Bromofluorobenzene	80-123	NA
Laboratory Control Samples			
SW-846 8260C	Spiking Compounds		
	1,2-Dichloroethane	60-137	NA
	Chloroform	67-132	NA
	Methylene chloride	31-124	NA
	Surrogate Spikes		
	1,2-Dichloroethane-d4	69-132	NA
	Dibromofluoromethane	80-120	NA
	Toluene-d8	81-120	NA
	4-Bromofluorobenzene	85-115	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) The control limits listed are subject to change. The limits are statistically derived and are regularly adjusted to match operating conditions. Depending on analyte list, reported spiking compounds may not include all listed above.

TABLE A1-b

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8260B and 8260C
CALIBRATION SPECIFICATION AND CORRECTIVE ACTION SUMMARY

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846, 8260B and 8260C Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Halogenated and Aromatic Volatile Organic Compounds	Tune instrument with a 4-bromofluorobenzene standard (BFB)	Every 12 hours	Must meet key ions and ion abundance criteria established by method (Refer to Table B1-d)	• Retune instrument • Repeat standard analysis
		Initial multi-point calibration; 5 point minimum. Lowest point at or below PQL. Includes calibration check on all analytes, and Internal Standards (IS) Compounds	Prior to analysis, and as required	If RSD < 20%, average RF may be used; if ≥ 20%, linear or quadratic calibration required	• Evaluate system • Repeat calibration
		Continuing calibration verification (CCV): IS Compounds	Every 12 hours	If 80% of total analytes have a percent difference ≤20%, CCV passes	• Evaluate system/standard • Reanalyze calibration check standard • Repeat initial calibration
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze method blank • Recalibrate
		Internal standards	Every sample, method blank, LCS, and MS/MSD	Retention time for each internal standard must be within 30 seconds of most recent CCV and the EICP area for all internal standards must be within -50% to +200% of the most recent CCV	• Evaluate system/standard • Reanalyze samples • If still out, report both sets of data • Narrate all outliers
		Surrogate spike	Every sample, method blank, LCS, MS/MSD	All surrogates must meet QC acceptance criteria.	• Reanalyze sample once • Re-extract and reanalyze any surrogate outside QC acceptance limits • If still out, report both sets of data • Narrate all outliers

TABLE A1-b

VOLATILE ORGANIC COMPOUNDS GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8260B and 8260C CALIBRATION SPECIFICATION AND CORRECTIVE ACTION SUMMARY (CONTINUED)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846, 8260B and 8260C Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)(con't)	Halogenated and Aromatic Volatile Organic Compounds	Matrix spike (MS)	1 per preparation batch (≤20 samples)	Percent recovery within QC acceptance criteria (Refer to Table A1-a)	• Assess data (4x rule) • Narrate all outliers
		Matrix spike duplicate (MSD)	1 per preparation batch (≤20 samples)	% Recovery and RPD within QC acceptance criteria (Refer to Table A1-a)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (Refer to Table A1-a)	• Reanalyze LCS • Reprep/reanalyze LCS and all associated samples • Narrate all outliers

EICP Extracted ion current profile
QC Quality control
RF Response factor
RPD Relative percent difference
RSD Relative Standard Deviation

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

TABLE A1-c(1)

VOLATILE ORGANIC COMPOUNDS -METHOD SW-846 8260B
PRACTICAL QUANTITATION LIMITS

Parameter	Analytical Method[a]	Analyte	Water PQL (µg/l)
Volatile Organic Compounds	SW-846 8260B	Acetone	10
		Acrolein	20
		Acrylonitrile	20
		Allyl Chloride	2
		Benzene	1
		Bromodichloromethane	1
		Bromoform	1
		Carbon disulfide	2
		Carbon tetrachloride	1
		Chlorobenzene	1
		Chloroethane	2
		Chloroform	1
		Chloroprene (2-chloro-1,3,-butadiene)	1
		Dibromochloromethane	1
		1,2-Dibromo-3-chloropropane	5
		1,2-Dibromoethane	1
		Trans-1,4-Dichloro-2-butene	3
		Dichlorodifluoromethane	2
		1,1-Dichloroethane	1
		1,2-Dichloroethane	1
		1,1-Dichloroethylene	1
		Trans-1,2-Dichloroethylene	1
		1,2-Dichloropropane	1
		cis-1,3-Dichloropropene	1
		trans-1,3-Dichloropropene	3
		Ethylbenzene	1
		2-Hexanone	5
		Methacrylonitrile	10
		Bromomethane	2
		Chloromethane	2
		Dibromomethane	1
		Methylene Chloride	5
		Methylethylketone (2-Butanone)	6
		Methyl Iodide (Iodomethane)	1
		Methylmethacrylate	4
		Methylisobutylketone	5
		Ethyl Methacrylate	3
		Propionitrile	20
		Styrene	1
		1,1,1.2-Tetrachloroethane	1
		1,1,2,2-Tetrachloroethane	1
		Tetrachloroethylene	1
		Toluene	1
		1,1,1-Trichloroethane	1
		1,1,2-Trichloroethane	1
		Trichloroethylene	1

TABLE A1-c(1)

VOLATILE ORGANIC COMPOUNDS- METHOD SW-846 8260B
PRACTICAL QUANTITATION LIMITS
(continued)

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Volatile Organic Compounds (continued)	SW-846 8260B	Trichlorofluoromethane	2
		1,2,3-Trichloropropane	1
		Vinyl acetate	3
		Vinyl chloride	1
		Xylene (total)	2

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) PQLs subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually

TABLE A1-c(2)

VOLATILE ORGANIC COMPOUNDS -METHOD SW-846 8260C
PRACTICAL QUANTITATION LIMITS

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Volatile Organic Compounds	SW-846 8260C	Acetone	10
		Acrolein	5
		Acrylonitrile	10
		Allyl Chloride	5
		Benzene	2
		Bromodichloromethane	2
		Bromoform	2
		Carbon disulfide	2
		Carbon tetrachloride	2
		Chlorobenzene	2
		Chloroethane	2
		Chloroform	2
		Chloroprene	2
		Dibromochloromethane	2
		1,2-Dibromo-3-chloropropane	5
		1,2-Dibromoethane	2
		1,2-dichlorobenzene	2
		1,3-dichlorobenzene	2
		1,4-dichlorobenzene	2
		Trans-1,4-Dichloro-2-butene	2
		Dichlorodifluoromethane	2
		1,1-Dichloroethane	2
		1,2-Dichloroethane	2
		1,1-Dichloroethylene	2
		Trans-1,2-Dichloroethylene	2
		1,2-Dichloropropane	2
		cis-1,3-Dichloropropene	2
		trans-1,3-Dichloropropene	2
		Ethylbenzene	2
		Ethyl methacrylate	2
		2-Hexanone	5
		Methacrylonitrile	5
		Bromomethane	5
		Chloromethane	5
		Dibromomethane	2
		Methylene Chloride	2
		Methylethylketone (2-Butanone)	10
		Methyliodide (Iodomethane)	5
		Methylmethacrylate	5
		Methylisobutylketone	5
		Pentachloroethane	5
		Proionitrile	25
		Styrene	2
		1,1,1.2-Tetrachloroethane	2
		1,1,2,2-Tetrachloroethane	2
		Tetrachloroethylene	2

TABLE A1-c(2)

VOLATILE ORGANIC COMPOUNDS- METHOD SW-846 8260C
PRACTICAL QUANTITATION LIMITS
(continued)

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Volatile Organic Compounds (continued)	SW-846 8260C	Toluene	2
		1,2,4-Trichlorobenzene	2
		1,1,1-Trichloroethane	2
		1,1,2-Trichloroehtane	2
		Trichloroethylene	2
		Trichlorofluoromethane	2
		1,2,3-Trichloropropane	2
		Vinyl acetate	5
		Vinyl chloride	1
		Xylene (total)	2

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) PQLs subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

TABLE A1-d

4-BROMOFLUOROBENZENE (BFB) MASS INTENSITY CRITERIA

Mass	Required Intensity (relative abundance)
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5 to 9% of mass 174
176	Greater than 95%, but less than 101% of mass 174
177	5 to 9% of mass 176

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846),
(U.S. EPA Third Edition, November 1986 and its updates).

TABLE A2-a

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY - SW-846 8270D
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

		Control Limits	
		Accuracy[b] Percent Recovery (%)	Precision[b] (RPD %)
Analytical Method[a]	Spiking Compounds	Water	Water
Matrix Spike/Matrix Spike Duplicate			
SW-846 8270D	Benzo(a)pyrene	15-169	25
	2,4,6-Trichlorophenol	10-223	25
	2,4-Dimethylphenol	10-176	25
	2,4-Dinitrotoluene	21-191	25
	2-Chloronaphthalene	12-132	25
	2-Chlorophenol	20-107	25
	4,6-Dinitro-2-methyl phenol	20-250	25
	4-Chloro-3-methylphenol	10-136	25
	4-Nitrophenol	10-135	25
	Acenaphthene	21-113	25
	N-nitroso-di-n-propylamine	10-133	25
	Pentachlorophenol	10-131	25
	Phenol	10-71	25
	Pyrene	23-150	25
	Surrogate Spikes		
	Nitrobenzene-d5	10-180	NA
	2-Fluorobiphenyl	10-124	NA
	Terphenyl-d14	10-199	NA
	Phenol-d6	10-122	NA
	2-Fluorophenol	10-106	NA
	2,4,6-Tribromophenol	14-159	NA
Laboratory Control Sample			
SW-846 8270D	Benzo(a)pyrene	39-152	NA
	2,4,6-Trichlorophenol	20-117	NA
	2,4-Dimethylphenol	10-131	NA
	2,4-Dinitrotoluene	42-219	NA
	2-Chloronaphthalene	23-126	NA
	2-Chlorophenol	15-114	NA
	4,6-Dinitro-2-methyl phenol	10-190	NA
	4-Chloro-3-methylphenol	29-148	NA
	4-Nitrophenol	10-114	NA
	Acenaphthene	20-116	NA
	Pentachlorophenol	23-162	NA
	Phenol	10-131	NA
	Pyrene	37-138	NA
	Surrogate Spikes		
	Nitrobenzene-d5	17-133	NA
	2-Fluorobiphenyl	18-113	NA
	Terphenyl-d14	28-163	NA
	Phenol-d6	10-124	NA
	2-Fluorophenol	10-121	NA
	2,4,6-Tribromophenol	10-165	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) The control limits listed are subject to change. The limits are statistically derived and are regularly adjusted to match operating conditions. Depending on analyte list, reported spiking compounds may not include all listed above.

TABLE A2-b

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY-SW-846 8270D
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270D Semi-Volatiles by GC/MS	Semi-Volatiles	Tune the instrument using a deca-fluorotriphenylphosine (DFTPP) standard	Every 12 hours	Must meet the ion abundance criteria specified in the method (Refer to Table A2-d) Degradation of DDT < 20% Benzidine and PCP present at normal response without excessive tailing	• Retune instrument • Repeat standard analysis • Perform injection port, column maintenance as necessary
		Initial calibration (5 point minimum); includes calibration check on all analytes, and Internal Standard (IS) Compounds	Prior to analysis and as required	If % RSD <20 % on all analytes, average RF may be used; if ≥20%, linear or quadratic calibration is required	• Evaluate the system • Repeat calibration
		Continuing calibration verification (CCV); includes IS Compounds	Every 12 hours	At least 80% of analytes have a percent difference of ≤20%	• Evaluate system/standard • Reanalyze calibration check standard • Repeat the initial calibration as necessary
		Method blank	1 per preparation batch (≤20 samples)	<Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Internal Standard	Every sample, method blank, LCS and MS/MSD	The EICP area for all internal standards must be within -50% and +200% of most recent CCV Retention time for each internal standard must be within 30 seconds of most recent CCV	• Evaluate system/standard • Reanalyze the sample • If still out, report both sets of data

TABLE A2-b

SEMI-VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY-SW-846 8270D CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY (CONTINUED)

Analytical Method[a]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270D Semi-Volatiles by GC/MS (con't)	Semi-Volatiles	Surrogate spike	Every sample, method blank, LCS and MS/MSD	All surrogates must be within acceptance criteria (Refer to Table A2-a) No surrogate below 10% recovery	• Reanalyze sample once • Re-extract and reanalyze if outside acceptance limits • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (Refer to Table A2-a)	• Assess data (4x rule) • Reanalyze once; report both sets of data • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	% Recovery and/or RPD within QC acceptance criteria (Refer to Table A2-a)	• Same as MS
		Laboratory control sample	1 per preparation batch (≤20 samples)	% Recovery within project QC acceptance criteria for all spiked analytes	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

EICP Extracted ion current profile
QC Quality control
RF Response factor
RPD Relative percent difference
RSD Relative standard deviation

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

TABLE A2-c

SEMI-VOLATILE ORGANIC COMPOUNDS METHOD SW-846 8270D
PRACTICAL QUANTITATION LIMITS

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Base/neutral, and acid extractables	SW-846 8270D	Acenaphthene	10
		Acenaphthylene	10
		Acetophenone	10
		2-Acetylaminofluorene	10
		4-Aminobiphenyl	10
		Aniline	10
		Anthracene	10
		Aramite	10
		Benzo(a)anthracene	10
		Benzo(b)fluoranthene	10
		Benzo(k)fluoranthene	10
		Benzo(g,h,i)perylene	10
		Benzo(a)pyrene	10
		Benzyl alcohol	10
		Bis(2-chloroethoxy)methane	10
		Bis(2-ethylhexyl)phthalate	10
		Bis(2-chloroethyl)ether	10
		Bis(2-chloroisopropyl)ether	10
		4-Bromophenylphenylether	10
		Butylbenzylphthalate	10
		4-chloroaniline	10
		Chlorobenzilate	10
		p-Chloro-m-cresol (4-chloro-3-methylphenol)	10
		2-chloronaphthalene	10
		2-Chlorophenol	10
		4-chlorophenyl phenyl ether	10
		Chrysene	10
		m & p-Cresol (3&4-methylphenol)	10
		o-Cresol (2-methylphenol)	10
		Diallate	10
		Dibenz(a,h)anthracene	10
		Dibenzofuran	10
		Di-n-butylphthalate	10
		3,3'-dichlorobenzidine	10
		2,4-Dichlorophenol	10
		2,6-Dichlorophenol	10
		Diethyl phthalate	10
		0,0-Diethyl,0-2-pyrazinyl phosphorothioate (thionazin)	10
		Dimthoate	10
		p-(dimethylamino)azobenzene	10
		7,12-Dimethylbenz(a)anthracene	10
		3,3'-Dimethylbenzidine	10
		a,a-Dimethylphenethylamine	10

TABLE A2-c

SEMI-VOLATILE ORGANIC COMPOUNDS METHOD SW-846 8270D PRACTICAL QUANTITATION LIMITS (CONTINUED)

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Base/neutral, and acid extractables	SW-846 8270D	2,4-Dimethylphenol	10
		Dimethyl phthalate	10
		1,3-Dinitrobenzene	10
		2,4-Dinitrophenol	20
		2,4-dinitrotoluene	10
		2,6-dinitrotoluene	10
		4,6-Dinitro-2-methyl phenol	10
		2-sec-Butyl-4,6-dinitrophenol (dinoseb)	10
		Di-n-octylphthalate	10
		Diphenylamine	10
		Disulfoton	10
		Ethyl methane sulfonate	10
		Famphur	10
		Fluoranthene	10
		Fluorene	10
		Hexachlorobenzene	10
		Hexachlorobutadiene	10
		Hexachlorocyclopentadiene	10
		Hexachloroethane	10
		Hexachlorophene	300
		Hexachloropropene	10
		Indeno (1,2,3-cd) pyrene	10
		Isodrin	10
		Isophorone	10
		Isosafrole	10
		Kepone	10
		Methylpyrilene	10
		3-Methylchloranthrene	10
		Methyl methanesulfonate	10
		2-methylnaphthalene	10
		Methyl parathion	10
		Naphthalene	10
		1,4-Naphthaquinone	10
		1-Napthylamine	10
		2-Napthylamine	10
		2-nitroaniline	10
		3-nitroaniline	10
		4-nitroaniline	10
		Nitrobenzene	10
		2-nitrophenol	10
		4-nitrophenol	10
		4-Nitroquinoline-1-oxide	10
		N-nitroso-di-n-butylamine	10
		N-nitrosodiethylamine	10
		N-nitrosodimethylamine	10
		N-nitrosodiphenylamine	10
		N-nitroso-di-n-propylamine	10
		N-nitrosomethylethylamine	10

TABLE A2-c

SEMI-VOLATILE ORGANIC COMPOUNDS METHOD SW-846 8270D
PRACTICAL QUANTITATION LIMITS
(CONTINUED)

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Base/neutral, and acid extractables	SW-846 8270D	N-nitrosomorpholine	10
		N-nitrosopiperidine	10
		N-nitrosopyrrolidine	10
		5-Nitro-o-toluidine	10
		Parathion	10
		Pentachlorobenzene	10
		Pentachloronitrobenzene	10
		Pentachlorophenol	10
		Phenanthrene	10
		Phenacetin	10
		Phenol	10
		1,4-Phenylenediamine	10
		Phorate	10
		2-Picoline	10
		Pronamide	10
		Pyrene	10
		Pyridine	10
		Safrole	10
		1,2,4,5-Tetrachlorobenzene	10
		2,3,4,6-tetrachlorophenol	10
		Tetraethyldithiopyrophosphate	10
		o-Toluidine	10
		2,4,5-trichlorophenol	10
		2,4,6-trichlorophenol	10
		0,0,0-Triethylphosphorothioate	10
		1,3,5-Trinitrobenzene	10

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) PQLs subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

TABLE A2-d

DECAFLUOROTRIPHENYL PHOSPHINE (DFTPP) KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present, but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

TABLE A3-a

ORGANOCHLORINE PESTICIDES AND PCBs BY GAS CHROMATOGRAPHY - METHODS SW-846 8081B AND 8082A QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Accuracy (% Recovery) [b] Water	Precision (RPD %) [b] Water
Matrix Spike/Matrix Spike Duplicate			
Pesticides	**Spike Compounds**		
SW-846 8081B	alpha-BHC	49-127	25
	beta-BHC	32-129	25
	delta-BHC	40-131	25
	gamma-BHC	45-138	25
	Heptachlor	14-136	25
	Aldrin	35-115	25
	Heptachlor epoxide	35-135	25
	Enodulfan I	33-137	25
	Dieldrin	43-131	25
	4,4'-DDE	10-196	25
	Endrin	44-137	25
	Endosulfan II	27-147	25
	4,4'-DDD	26-210	25
	Endosulfan Sulfate	44-138	25
	4,4'-DDT	10-161	25
	Endrin Aldehyde	10-166	25
	Surrogate Spike		
	Decachlorobiphenyl	10-123	NA
	Tetrachloro-m-xylene	44-121	NA
PCBs	**Spike Compounds**		
SW-846 8082A	Aroclor 1016	50-150	25
	Aroclor 1260	50-150	25
	Surrogate Spike		
	Decachlorobiphenyl	10-123	NA
	Tetrachloro-m-xylene	44-121	NA

TABLE A3-a

ORGANOCHLORINE PESTICIDES AND PCBs BY GAS CHROMATOGRAPHY - METHODS SW-846 8081B AND 8082A QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION (CONTINUED)

Analytical Method[a]	Spiking Compounds	Accuracy (% Recovery) [b] Water	Precision (RPD %) [b] Water
Laboratory Control Sample			
Pesticides SW-846 8081B	**Spike Compounds**		
	alpha-BHC	46-135	NA
	beta-BHC	47-131	NA
	delta-BHC	46-138	NA
	gamma-BHC	44-135	NA
	Heptachlor	45-123	NA
	Aldrin	31-134	NA
	Heptachlor epoxide	43-137	
	Enodulfan I	55-132	NA
	Dieldrin	43-138	NA
	4,4'-DDE	14-164	NA
	Endrin	40-148	NA
	Endosulfan II	11-139	NA
	4,4'-DDD	38-164	NA
	Endosulfan Sulfate	41-138	NA
	4,4'-DDT	44-128	NA
	Endrin Aldehyde	10-134	
	Surrogate Spike		
	Decachlorobiphenyl	46-140	NA
	Tetrachloro-m-xylene	28-140	NA
PCBs SW-846 8082A	**Spike Compounds**		
	Aroclor 1016	35-129	NA
	Aroclor 1260	43-132	NA
	Surrogate Spike		
	Decachlorobiphenyl	16-155	NA
	Tetrachloro-m-xylene	28-140	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) The control limits listed are subject to change. The limits are statistically derived and are regularly adjusted to match operating conditions. Depending on analyte list, reported spiking compounds may not include all listed above.

TABLE A3-b

ORGANOCHLORINE PESTICIDES AND PCBs BY GAS CHROMATOGRAPHY – METHODS SW-846 8081B AND 8082A CALIBRATIONS SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081B Organochlorine Pesticides by Gas Chromatography SW-846 8082A PCBs by Gas Chromatography	Organochlorine Pesticides Polychlorinated Biphenyls (PCBs)	Column Evaluation Mix	Prior to analysis, both initial and daily	• Degradation of DDT and Endrin < 15%	• Evaluate the system • Repeat standard
		Initial calibration (ICAL) (5 point minimum) Lowest at or below PQL Mid level multi-component standards for pattern recognition and retention times	Prior to analysis and as required	• If RSD < 20%, average CF may be used; if ≥20%, linear (5-point), quadratic (6-point), or cubic (7-point) calibration required	• Average RSD <20% across all analytes may be used if any analyte fails • Evaluate the system • Repeat initial calibration
		Initial calibration verification (ICV) Mid level standard Expected multi-component compounds	Prior to every analytical sequence	• % Difference ≤15% of expected concentration compared to response from ICAL	• Average % difference ≤15% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze ICV standard • Repeat initial calibration
		Continuing calibration verification (CCV) Mid level standard Expected multi-component compounds	After every 10 samples and at the end of the analytical sequence	• % Difference ≤20% of expected concentration compared to response from ICAL for each bracketing standard	• Average % difference ≤20% across all analytes may be used if any analyte fails • Evaluate system/standard • Reanalyze CCV and affected samples
		Retention time windows	Established with each new column installation Updated with each daily initial Calibration standard	• Retention times must be within retention time window established by the daily initial calibration standard • Every CCV and every sample	• Evaluate system/standard; pattern recognition may be sufficient for multi-component compounds only • Reanalyze CCV/affected samples
		Method Blank	1 per preparation batch (≤ 20 samples)	• < ½ Practical Quantitation Limit (PQL)	• Reanalyze blank • Re-prep/reanalyze blank and associated samples

TABLE A3-b

ORGANOCHLORINE PESTICIDES AND PCBs BY GAS CHROMATOGRAPHY – METHODS SW-846 8081B AND 8082A CALIBRATIONS SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY (CONTINUED)

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081B Organochlorine Pesticides by Gas Chromatography SW-846 8082A PCBs by Gas Chromatography (con't)	Organochlorine Pesticides Polychlorinated Biphenyls (PCBs)	Surrogate spike DCB and TCMX	Every sample, method blank, LCS and MS/MSD	• % Recovery within QC acceptance criteria (Refer to Table B12-a) • At least one surrogate must be within QC acceptance criteria	• Re-extract/reanalyze once • If still out, report both sets of data • Narrate all outliers
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B3-a)	• No corrective action based on MS alone • Narrate all outliers
		Matrix spike duplicate(MSD)	1 per preparation batch (≤20 samples)	• % Recovery and/or RPD within QC acceptance criteria (Refer to Table B3-a)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	• % Recovery within QC acceptance criteria (Refer to Table B3-a)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

%RSD Relative standard deviation
CF Calibration factor
QC Quality control
RPD Relative percent difference

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

TABLE A3-c
ORGANOCHLORINE PESTICIDES AND PCBs BY GAS CHROMATOGRAPHY - METHODS SW-846 8081B and 8082A
PRACTICAL QUANTITATION LIMITS

Analysis	Analytical Method[(a)]	Analyte	Water PQL[(b)] (µg/l)
Organochlorine Pesticides	SW-846 8081B	Aldrin	0.10
		alpha-BHC	0.10
		beta-BHC	0.10
		delta-BHC	0.10
		gamma-BHC (Lindane)	0.10
		Chlordane	0.20
		4,4'-DDD	0.10
		4,4'-DDE	0.10
		4,4'-DDT	0.10
		Dieldrin	0.10
		Endosulfan I	0.10
		Endosulfan II	0.10
		Endosulfan sulfate	0.10
		Endrin	0.10
		Endrin aldehyde	0.10
		Heptachlor	0.10
		Heptachlor epoxide	0.10
		Isodrin	0.10
		Methoxychlor	0.10
		Toxaphene	0.20
Polychlorinated Biphenyls (PCBs)	SW-846 8082A	Aroclor 1016	0.5
		Aroclor 1221	0.5
		Aroclor 1232	0.5
		Aroclor 1242	0.5
		Aroclor 1248	0.5
		Aroclor 1254	0.5
		Aroclor 1260	0.5

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) PQLs subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

TABLE A4-a

INDUCTIVELY COUPLED PLASMA METALS ANALYSIS - SW-846 6010C OR 6020A QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Accuracy Percent Recovery (%) Water	Precision (RPD %) Water
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate[b]			
Metals—SW-846 6010C or 6020A	Antimony	70-130	20
	Arsenic	70-130	20
	Barium	70-130	20
	Beryllium	70-130	20
	Calcium	75-125	20
	Cadmium	70-130	20
	Cobalt	70-130	20
	Copper	70-130	20
	Chromium	70-130	20
	Iron	75-125	20
	Lead	70-130	20
	Magnesium	75-125	20
	Molybdenum	70-130	20
	Nickel	70-130	20
	Potassium	75-125	20
	Selenium	70-130	20
	Sodium	75-125	20
	Silver	70-130	20
	Thallium	70-130	20
	Vanadium	70-130	20
	Zinc	70-130	20
Laboratory Control Sample			
Metals—SW-846 6010C or 6020A	Antimony	85-115	NA
	Arsenic	85-115	NA
	Barium	85-115	NA
	Beryllium	85-115	NA
	Calcium	75-125	NA
	Cadmium	85-115	NA
	Cobalt	85-115	NA
	Copper	85-115	NA
	Chromium	85-115	NA
	Iron	75-125	NA
	Lead	85-115	NA
	Magnesium	75-125	NA
	Molybdenum	85-115	NA
	Nickel	85-115	NA
	Potassium	75-125	NA
	Selenium	85-115	NA
	Sodium	75-125	NA
	Silver	85-115	NA
	Thallium	85-115	NA
	Vanadium	85-115	NA
	Zinc	85-115	NA

NA Not applicable
RPD Relative percent difference
(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).
(b) RPD calculated between parent sample and matrix duplicate.

TABLE A4-b

INDUCTIVELY COUPLED PLASMA METALS ANALYSIS - SW-846 6010C or 6020A
CALIBRATION SPECIFICATION AND CORRECTIVE ACTION PROCEDURES

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 6010C or 6020A Inductively Coupled Plasma Atomic Emission Spectrometry	Metals	Initial calibration (1 point + blank minimum)	Daily prior to analysis	Correlation coefficient (r) >0.995	• Recalibrate
		Interference check standard (ICS)	Beginning and end of each analytical run	Results +/- 20% of true value	• Terminate analysis • Recalibrate instrument • Reanalyze all samples back to last acceptable ICS
		Initial calibration verification (ICV)	After calibration, prior to sample analysis	Results <10% from calibration standard	• Reanalyze ICV • Recalibrate, if ICV still out
		Continuing calibration verification (CCV)	Every 10 samples and end of analytical sequence	Results < 10% from calibration standard	• Reanalyze affected samples back to the last acceptable CCV
		Calibration blank - Initial calibration blank (ICB), Continuing calibration blank (CCB)	After initial calibration verification, each subsequent calibration verification, and at the end of the run	<3x the Method detection limit (MDL)	• Reanalyze blank • Clean system • Reanalyze all samples back to last acceptable blank
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery +/-25% of actual value	• Assess data (5x rule) • Reanalyze/ reprep once • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	RPD <20%	• Same as MS
		Laboratory Control Sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery +/- 20% of actual value	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers

RPD Relative percent difference

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA November 1986 and its updates).

TABLE A4-c

ICP METALS ANALYSIS METHOD SW-846 6010C AND 6020A
PRACTICAL QUANTITATION LIMITS

Parameter	Analytical Method[a]	Analyte	Water PQL[b] (µg/l)
Metals	SW 6010C or 6020A	Antimony	5
		Arsenic	5
		Barium	20
		Beryllium	2
		Calcium	1000
		Cadmium	4
		Cobalt	10
		Copper	50
		Chromium	10
		Iron	100
		Lead	5
		Magnesium	1000
		Molybdenum	25
		Nickel	50
		Potassium	1000
		Selenium	5
		Sodium	1000
		Silver	15
		Thallium	2
		Vanadium	15
		Zinc	25

µg/l micrograms per liter

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) Practical Quantitation Limits (PQLs) subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

TABLE A5-a

GRAPHITE FURNACE AND COLD VAPOR ATOMIC ABSORPTION METALS ANALYSIS – SW-846 7000 SERIES QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Accuracy Percent Recovery (%) Water	Precision (RPD %) Water
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate[b]			
Metals-SW-846 7000 Series			
	Mercury	85-115	20
Laboratory Control Sample			
Metals-SW-846 7000 Series			
	Mercury	85-115	NA

NA Not applicable

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) Relative percent difference (RPD) calculated between parent sample and matrix duplicate.

TABLE A5-b

GRAPHITE FURNACE AND COLD VAPOR ATOMIC ABSORPTION METALS ANALYSES - SW-846 7000 SERIES
CALIBRATION SPECIFICATIONS AND CORRECTIVE ACTION SUMMARY

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SW-846 7000 Series Graphite Furnace And Cold Vapor Atomic Absorption	Metals	Initial multipoint calibration (3 point + blank minimum)	Daily, prior to analysis	Correlation coefficient (r) ≤0.995	• Recalibrate
		Initial calibration verification (ICV); mid-level standard	After calibration, prior to sample analysis	± 10% of true value	• Reanalyze ICV • Rerun initial calibration
		Continuing calibration verification (CCV); mid-level standard	Every 10 samples and at end of analytical sequence	± 20% of true value	• Reanalyze affected samples back to last acceptable CCV
		Calibration blank (ICB/CCB)	After calibration, and after each subsequent calibration verification	< Method detection limit (MDL)	• Reanalyze blank • Clean system if still out • Reanalyze affected samples back to last acceptable CCB
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze method blank. • If fails, analyze a calibration blank • Reprep/reanalyze analytical batch as appropriate
		Dilution Test	1 per analytical batch	Recovery between 90-110% of undiluted sample	• Analyze a post-digestion spike sample
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within +/- 25% of true value	• Assess data (5x rule) • Use method of standards addition to compensate for matrix interferences
		Matrix spike duplicate (MSD) or Matrix Duplicate (MD)	1 per preparation batch (≤20 samples)	RPD < 20%	• Same as MS
		Laboratory control samples (LCS)	1 per preparation batch (≤20 samples)	% Recovery within +/- 20%	• Reanalyze LCS • Reprep/reanalyze LCS and affected samples • Narrate all outliers

MDL Method detection limit
RPD Relative percent difference

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

TABLE A5-c

GRAPHITE FURNACE AND COLD VAPOR ATOMIC ABSORPTION METALS ANALYSIS METHOD SW-846 7000 SERIES PRACTICAL QUANTITATION LIMITS

Parameter	Analytical Method[(a)]	Analyte	Water PQL[(b)] (µg/l)
Metals	SW-846 7000 Series	Mercury	0.5

µg/l micrograms per liter

(a) EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), (U.S. EPA Third Edition, November 1986 and its updates).

(b) Practical Quantitation Limits (PQLs) subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

TABLE A6-b(1)

GRAVIMETRIC DETERMINATION OF TOTAL DISSOLVED SOLIDS CALIBRATION SPECIFICATIONS, CORRECTIVE ACTION SUMMARY, AND QUALITY CONTROL CRITERIA

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SM 2540 C Gravimetric	Total Dissolved Solids	Balance calibration (0.5g, 5.0g, 50g Class S weights)	Prior to each batch	Difference between measured and true weights must fall within acceptance limits	• Recalibrate
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	RPD within QC acceptance criteria (20%)	• Evaluate LCS
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (80-120%)	• Reanalyze LCS • Reprep/reanalyze all associated samples • Narrate all outliers

g Gram
RPD Relative percent difference
QC Quality control

(a) SM refers to the 20th Edition of Standard Methods for the Examination of Water and Wastewater.

TABLE A6-b(2)

GRAVIMETRIC DETERMINATION OF TOTAL SUSPENDED SOLIDS
CALIBRATION SPECIFICATIONS, CORRECTIVE ACTION SUMMARY, AND QUALITY CONTROL CRITERIA

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SM 2540 D Gravimetric	Total Suspended Solids	4.7 cm diameter filter	Filter 100 ml of sample	Weight of captured residue must be > 1.0 mg	• Increase sample volume
		Method blank	1 per preparation batch (≤ 20 samples)	< Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix duplicate (MD)	1 per preparation batch (≤ 20 samples)	RPD within QC acceptance criteria (20%)	• Evaluate LCS
		Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	% Recovery within QC acceptance criteria (80-120%)	• Reanalyze LCS • Reprep/reanalyze all associated samples • Narrate all outliers

mg milligram
ml milliliter
RPD Relative percent difference
QC Quality control

(a) SM refers to the 20th Edition of Standard Methods for the Examination of Water and Wastewater.

TABLE A6-b(3)
DETERMINATION OF ANIONS - STANDARD METHODS AND EPA 300 SERIES METHODS
CALIBRATION SPECIFICATIONS, CORRECTIVE ACTION SUMMARY, AND QUALITY CONTROL CRITERIA

Analytical Method[a,b]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SM 4500-F-C – ion selective electrode[c,d] SM 4500-SO4-E – turbidimetric[c,e] SM 4500-CL-E – automated ferricyanide[c]	Fluoride Sulfate Chloride	Initial multipoint calibration (minimum of three concentrations plus blank) The chloride method has an initial standard check rather than a calibration requirement	Initially and as required	Correlation coefficient (r) ≥0.995	• Check calculations • Recalibrate
EPA 300.0 – ion chromatography	Bromide	Initial calibration verification (ICV) Chloride has an initial standard check	Daily, prior to sample analysis	± 10% of expected concentration	• Reanalyze ICV • Recalibrate if ICV still out
		Continuing calibration verification (CCV) mid-range. Chloride requires a continuing standard check.	Every 10 samples and at end of run	± 5% of expected concentration	• Reanalyze affected samples back to last acceptable CCV
		Calibration blank- Initial calibration blank (ICB), Continuing calibration blank (CCB) Calibration blanks are not used for chloride	Daily after each ICV and CCV	< Practical quantitation limit (PQL)	• Reanalyze blank • Clean system • Reanalyze samples back to last clean blank
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (fluoride and sulfate 80-120%, bromide and chloride 90-110%)	• Assess data (5x rule) • Reanalyze once, report both sets • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	RPD within QC acceptance criteria (10%,, except bromide, which is 20%)	• Assess data • Reanalyze once, report both sets of data • Narrate all outliers
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (90-110%)	• Reanalyze LCS • Reprep/reanalyze all associated samples • Narrate all outliers

QC Quality control
RPD Relative percent difference
(a) EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
(b) SM refers to the 20th Edition of Standard Methods for the Examination of Water and Wastewater.
(c) EPA 300.0 can be substituted with justification and approval prior to analysis from the Energy*Solutions* Director of Compliance and Permitting or designee.
(d) TestAmerica Denver (TAD) will analyze samples for fluoride by EPA 300.0.
(e) TestAmerica Denver (TAD) will analyze samples for sulfate by ASTM D516-02. ASTM Standard D516-02, 2002, "Standard Test Method for Sulfate Ion in Water." ASTM International.

TABLE A6-b(4)

TITRIMETRIC DETERMINATION OF ALKALINITY- STANDARD METHOD 2320 B
CALIBRATION SPECIFICATIONS, CORRECTIVE ACTION SUMMARY, AND QUALITY CONTROL CRITERIA

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
SM 2320 B Titrimetric	Alkalinity Bicarbonate Carbonate	Initial calibration	Initially and as required	According to manufacturer's instructions	According to manufacturer's instructions
		Initial calibration verification (ICV)	Prior to sample analysis	± 10% of expected concentration	• Reanalyze ICV • Recalibrate if ICV still out
		Continuing calibration verification (CCV)	Every 20 samples and at end of run	± 10% of expected concentration	• Reanalyze affected samples back to last acceptable CCV
		Calibration blank - Initial calibration blank (ICB), Continuing calibration blank (CCB)	Daily after each ICV and CCV	< Practical quantitation limit (PQL)	• Reanalyze blank • Clean system • Reanalyze samples back to last clean blank
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (80-120 %)	• Assess data (5x rule) • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	RPD within QC acceptance criteria (10%)	• Assess data • Narrate all outliers
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (90-110%)	• Reanalyze LCS • Reprep/reanalyze all associated samples • Narrate all outliers

QC Quality control
RPD Relative percent difference

(a) SM refers to the 20th Edition of Standard Methods for the Examination of Water and Wastewater.

TABLE A6-b(5)

DETERMINATION OF NITRATE-NITRITE NITROGEN BY AUTOMATED COLORIMETRY- EPA 353.2
CALIBRATION SPECIFICATIONS, CORRECTIVE ACTION SUMMARY, AND QUALITY CONTROL CRITERIA

Analytical Method[a,b]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA 353.2 Colorimetry	Nitrate (as N) Nitrate-Nitrite (as N)	Initial multipoint calibration (minimum of three concentrations plus blank)	Initially and as required	Correlation coefficient, r ≥0.995	• Check calculations • Recalibrate
		Initial calibration verification (ICV)	Prior to sample analysis	± 10% of expected concentration	• Reanalyze ICV • Recalibrate if ICV still out
		Continuing calibration verification (CCV)	Every 20 samples and at end of run	± 10% of expected concentration	• Reanalyze affected samples back to last acceptable CCV
		Calibration blank - Initial calibration blank (ICB), Continuing calibration blank (CCB)	Daily after each ICV and CCV	< Practical quantitation limit (PQL)	• Reanalyze blank • Clean system • Reanalyze samples back to last clean blank
		Method blank	1 per preparation batch (≤20 samples)	< Practical quantitation limit (PQL)	• Reanalyze blank • Reprep/reanalyze blank and all associated samples
		Matrix spike (MS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (90-110 %)	• Assess data (5x rule) • Narrate all outliers
		Matrix spike duplicate (MSD) or Matrix duplicate (MD)	1 per preparation batch (≤20 samples)	RPD within QC acceptance criteria (10 %)	• Assess data • Narrate all outliers
		Laboratory control sample (LCS)	1 per preparation batch (≤20 samples)	% Recovery within QC acceptance criteria (90-110 %)	• Reanalyze LCS • Reprep/reanalyze all associated samples • Narrate all outliers

QC Quality control
RPD Relative percent difference

(a) EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).
(b) EPA 300.0 can be substituted with justification and approval prior to analysis from the EnergySolutions Director of Compliance and Permitting or designee

TABLE A6-b(6)

DETERMINATION OF TOTAL CYANIDE BY AUTOMATED COLORIMETRY – EPA 335.4
CALIBRATIONS SPECIFICATION AND CORRECTIVE ACTION SUMMARY

Analytical Method[(a)]	Parameter	QC Element	Frequency	Acceptance Criteria	Corrective Action
EPA 335.4 – Colorimetry	Cyanide	Initial calibration (3 point minimum) Lowest at or below PQL	Prior to analysis and as required	Correlation coefficient, r >0.995	• Evaluate the system • Repeat initial calibration
		High and low standards should be distilled and compared to the curve	Prior to analysis	% Difference < 10% of the undistilled standards	• Evaluate system/standard • Repeat initial calibration
		Continuing calibration verification (CCV)	Every analytical batch	% Difference < 15% of expected concentration	• Evaluate system/standard • Reanalyze CCV and samples back to last acceptable CCV
		Method Blank	1 per preparation batch (≤ 20 samples)	< Practical Quantitation Limit (PQL)	• Reanalyze blank • Re-prep/reanalyze blank and associated samples
		Matrix spike (MS)	1 per preparation batch (≤ 20 samples)	% Recovery within QC acceptance criteria (90-110%)	• No action based on MS alone • Narrate all outliers
		Matrix spike Duplicate	1 per preparation batch (≤ 20 samples)	% Recovery and RPD within QC acceptance criteria (10%)	• Same as MS
		Laboratory control sample (LCS)	1 per preparation batch (≤ 20 samples)	% Recovery within QC acceptance criteria (90-110%)	• Reanalyze LCS • Re-prep/reanalyze LCS and all associated samples • Narrate all outliers

RPD Relative percent difference
QC Quality control

(a) EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).

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TABLE A6-c

GROUNDWATER ANIONS AND WATER QUALITY PARAMETER PRACTICAL QUANTITATION LIMITS

Analytical Method[a]	Analyte	Water PQL[b] (mg/l)
SM 2540 C	Total Dissolved Solids	10
SM 2540 D	Total Suspended Solids	3
EPA 300.0	Bromide	0.5[c]
SM 4500-CL-E[d]	Chloride	5[c]
SM 4500-F-C[d,e]	Fluoride	0.1[c]
SM 4500-SO4-E[d,f]	Sulfate	5[c]
EPA 353.2[d]	Nitrate	0.01[c]
EPA 353.2[d]	Nitrite	0.01[c]
SM 2320 B	Alkalinity-Carbonate	10
	-Bicarbonate	10
	-Hydroxide	10
EPA 335.4	Cyanide	0.005

(a) EPA 100-400 Series - Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600R-93/100, August 1993).

SM refers to the 20th Edition of Standard Methods for the Examination of Water and Wastewater.

(b) Practical Quantitation Limits (PQLs) subject to change. May differ slightly as a result of the required Method Detection Limit study performed annually.

(c) Due to high chloride concentrations, dilution is necessary. Elevated PQLs are expected. Historically, this causes non-detects for fluoride, sulfate, nitrate and nitrite.

(d) EPA 300.0 can be substituted with justification and approval prior to analysis from the EnergySolutions Director of Compliance and Permitting or designee.

(e) TestAmerica Denver (TAD) will analyze samples for fluoride by EPA 300.0.

(f) TestAmerica Denver (TAD) will analyze samples for sulfate by ASTM D516-02.

mg/l milligram per liter

TABLE A7-a

GROUNDWATER RADIOLOGIC PARAMETERS
QUALITY CONTROL CRITERIA FOR LABORATORY DATA EVALUATION

Analytical Method[a]	Spiking Compounds	Accuracy Percent Recovery (%)	Precision (RER)[b]
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate			
EPA 900.0	Gross Beta	75-125% +CtE[c]	≤3.00
EPA 901.1	Potassium-40	75-125% +CtE	≤3.00
EPA R4-73-014I	Iodine-129	75-125% +CtE	≤3.00
EPA 903.1	Radium-226	75-125% +CtE	≤3.00
EPA 904.0	Radium-228	75-125% +CtE	≤3.00
EPA 905.0	Strontium-90	75-125% +CtE	≤3.00
EPA 906.0	Tritium	75-125% +CtE	≤3.00
HASL 300 Mod	Neptunium-237	75-125% +CtE	≤3.00
HASL 300	Uranium-234	75-125% +CtE	≤3.00
	Uranium-235/236	75-125% +CtE	≤3.00
	Uranium-238	75-125% +CtE	≤3.00
EPA C-01/EPA 520	Carbon-14	75-125% +CtE	≤3.00
HASL 300	Thorium-230	75-125% +CtE	≤3.00
	Thorium-232	75-125% +CtE	≤3.00
HASL 300	Technetium-99	75-125% +CtE	≤3.00
ASTM D5174-97	Total Uranium	75-125% +CtE	≤3.00

(a) ASTM Standard D5174-97, 1997. "Standard Test Method for Trace Uranium in Water by Pulsed-Laser Phosphorimetry." ASTM International, West Conshohocken, PA.

Environmental Measurements Laboratory (EML), 1997. HASL-300, The Procedures Manual of the Environmental Measurements Laboratory, 28th Ed. U.S. Department of Homeland Security, New York, NY. February, 1997.

U.S. Environmental Protection Agency, 1973. Procedures for the Radiochemical Analysis of Nuclear Reactor Aqueous Solutions. EPA-R4-73-014.

U.S. Environmental Protection Agency, 1980. Prescribed Procedures for Measurement of Radioactivity in Drinking Water. Environmental Monitoring and Support Laboratory, Cincinnati, OH. EPA-600/4-80-032, August, 1980.

U.S. Environmental Protection Agency, Office of Radiation Programs, 1984. Eastern Environmental Radiation Facility Radiochemistry Procedures Manual. Eastern Environmental Radiation Facility, Montgomery, AL. EPA 520/5-84-006, August, 1984.

(b) RER Replicate Error Ratio (calculated between parent sample and matrix duplicate).
(c) CtE Counting Error

TABLE A7-b

Reserved

TABLE A7-c

GROUNDWATER RADIOISOTOPES, ANALYTICAL METHODS, AND WATER QUALITY PRACTICAL QUANTITATION LIMITS

Analytical Method[a]	Analyte	Water PQL (pCi/l)
EPA 900.0	Gross Beta	200
EPA 901.1	Potassium-40	250
EPA R4-73-014I	Iodine-129	11
EPA 903.1	Radium-226	0.6
EPA 904.0	Radium-228	1.8
EPA 905.0	Strontium-90	5
EPA 906.0	Tritium	400
HASL 300 Mod	Neptunium-237	4
HASL 300	Uranium-233[b]/234 Uranium-235/236[c] Uranium-238	0.6 0.6 0.6
EPA C-01/EPA 520	Carbon-14	30
HASL 300	Thorium-230 Thorium-232	0.6 0.7
HASL 300	Technetium-99	15
ASTM 5174.97	Total Uranium	5 µg/l

(a) ASTM Standard D5174-97, 1997. "Standard Test Method for Trace Uranium in Water by Pulsed-Laser Phosphorimetry." ASTM International, West Conshohocken, PA.

Environmental Measurements Laboratory (EML), 1997. HASL-300, The Procedures Manual of the Environmental Measurements Laboratory, 28th Ed. U.S. Department of Homeland Security, New York, NY. February, 1997.

U.S. Environmental Protection Agency, 1973. Procedures for the Radiochemical Analysis of Nuclear Reactor Aqueous Solutions. EPA-R4-73-014.

U.S. Environmental Protection Agency, 1980. Prescribed Procedures for Measurement of Radioactivity in Drinking Water. Environmental Monitoring and Support Laboratory, Cincinnati, OH. EPA-600/4-80-032, August, 1980.

U.S. Environmental Protection Agency, Office of Radiation Programs, 1984. Eastern Environmental Radiation Facility Radiochemistry Procedures Manual. Eastern Environmental Radiation Facility, Montgomery, AL. EPA 520/5-84-006, August, 1984.

(b) Not available due to significant over lap of spectrum with U-234.

(c) Not available as spectrum are nearly coincident for U-235 and U-236, so are reported together.

µg/l micrograms per liter

pCi/l picocuries per liter